ComEd
“Development of competences of educational staff by integrating exploraton tasks into measures of vocational training and further education”

Best-Practice-
Presentation of preparation and implementation of exploration tasks (Teaching and learning arrangements)
-
Manual

(Status: 09/2010)

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This project has been funded with support from the European Commission.
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1 Background, problems and objectives in the project ComEd

Vocational training and further education in areas of high-technology as micro- and nanotechnologies require new methods in order of strengthening the part of teachers and trainers. Due to the dynamics of technical-technological developments and a high variety of products, materials and technologies in MNT enterprises the need of educational concepts and offers is different and changes quickly. Considering this situation there are special requirements in order of developing and designing educational processes and developing the competences of the educational staff. In addition to a continuous development of new knowledge from international research it has to be implicated know-how generated in companies in teaching and learning processes as well.

A suitable approach encouraging the development of competences of the educational staff is a stronger implication of exploration tasks aiming on working processes, carried out by apprentices or participants of further education. Explored information about working processes, problems, approaches of solutions and innovative development results are an important potential of learning for teachers and trainers.

Our project deals with a model of integrating exploration tasks in vocational training and further education, which was primarily developed and proved in other German industrial sectors. This model has been adapted in the context of qualifying the educational staff of MNT enterprises and educational service provider (ESP) and transferred to the European partner countries. As a result a model has been further developed on an European scale which includes products fostering European exchange (e. g. pool of operational tasks, handouts and a web based exchange platform for multipliers, teachers and trainers).

Furthermore it was the common effort of all partners to adjust the understanding of vocational training and further education in order to force the economical development in Europe. The partnership which realised the project ComEd, involves educational service provider for companies of MNT. These ESPs have a different institutional background and different focus on professional topics concerning vocational training and further education. ESPs will complement one another and assure a wide consideration of learning content.

Main objectives of ComEd were:

- **Strengthening the role of qualified employees** including educational staff within vocational training and further education in the field of MNT in terms of new functions and tasks in conjunction with high dynamic of technical-technological development

- **Increasing mobility of apprentices in MNT**
  Actually, apprentices in industrial-technical occupations in mobility projects are comparatively low. For that reason, preconditions for future European mobility projects for apprentices in companies of MNT shall be created simultaneously within the project ComEd

Target groups of project were:

- **Education personnel** within vocational training and further education for MNT involved in transfer (teachers, trainers in educational institutions and in SME) and
- based on it, **learners** within vocational training and further education in MNT in all involved countries during proving of concepts and instruments

2 The teaching and learning method „exploration task“

Method

The Exploration in enterprises is a special work order to learners. It focuses on the independent recording, documenting, evaluating and presenting objects, phenomena or processes of a professional or occupational reality. Thereby the exploration is orientated at the business process (as opposed to factory tours and excursions). The elaboration of various learning situations based on the exploration of business processes (including production and training processes). For learners, teachers and trainers the explorations lead to a better understanding of professional actions. Especially teachers and trainers get an current insight into the operational practice.

Fields of applications of exploration in enterprises

The exploration in enterprises may relate to various aspects of the professional reality and services in the company. A wealth of variations are possible starting from the typical job descriptions in the professionalism to the (partial)description of the work and process design in the value chain up to the task description of parts of the company. Explorations can also fulfill different functions in the learning and training process. These include e.g. the preparation for new thematic contents as an independent project work as well as to "review" acquired theoretical knowledge in practice.

Use of explorations as an instrument of skills development

Educational institutions should strive for an systematic integration of exploration in enterprises (cf. Further developed conception for integrating the learning/teaching method „Exploration in enterprises“ into the configuration of measures concerning vocational training and further education in the field of Micro- and Nanotechnologies with recommendations for its institutionalization in the educational processes).

The exploration in enterprises is a conceptional demanding method. Therefore, it is necessary to make trainers and teachers become familiar with the tool and to train them for use (cf. „Hand-out/Manual for sensitisation and qualification of educational staff for being able to realize the concept).

Didactical-methodological implementation

In preparation for an exploration the learner should get explanations with regards to the content. In addition the trainers have to make transparent the learning targets. The learners should realize that they have a wealth of learning opportunities on technical and personal aspects while performing an exploration task.

What are possible overlapping learning targets?

- Identification and evaluation of operational connections and sequences
- Become acquainted with sequences and aspects of the operational reality
- Get insights into operational practice and the associated professional reality
- Adjustment of theoretical knowledge with the professional realities
- Identification of fields for contributing own design competences
- Strengthen the personal and social skills

- Improving the methodological competence regarding to research and documentation processes as well as the presentation of results
- Improving communication skills
- Deepen the understanding of the conditions of work and professional reality

Not any exploration task can designed to cover all learning targets in equal measure. As mentioned above, the exploration task can be used in different contexts and functions and serve different purposes. If it is carried out by the students in preparation and getting into a new subject, the imparting of factual knowledge is in the foreground.

Generally, it can be assumed that an well elaborated prepared and post processed exploration task offers a sufficient guarantee to achieve the intended learning targets.

3 Best practices

BEST PRACTICE

ILLUSTRATING THE PROFESSION OF A MICRO-TECHNOLOGIST

Abstract

The exploration task provides the possibility to the apprentices to learn about the professional image of the micro-technologists in detail.
At the same time the exchange of expertise between the learners will be encouraged and social skills can be promoted .
As a joint result a board with explanation of the profession and different fields of applications can be generated.
The board is a useful medium to promote the profession on events of occupational orientation.

Background

Micro-technologist as profession is relatively new on German vocational training market. So far it is not known in many companies and vocational schools.

At the same time, there is a high need for extensive and well-trained manpower, which will continue increasing. However, it is just as important, to find interested parties for this profession and to popularise the micro-technologist for future qualified employees. These target groups are students, trainees and job seekers in retraining.

Objectives

This exploration task is directed to apprentices at the start of their initial vocational training to micro-technologist. It pursues the intention to consolidate for the trainees the contents of the vocational training and the understanding for the profession.

The apprentices were asked to deal in detail with the profession micro-technologist. It should be note the following aspects:

- What is the training period?
- What are application areas?
- Please describe the training content!
- Which kind of specialisations are there within vocational training?
- Give some information about clean rooms and clean room conditions.
- Which tests have to be passed?

An important requirement of this exploration task is on one hand the correctness with regards to content and on the other hand realizing a compact and visually attractive illustration.

Results/Solutions

As a result the students should present the information in form of a board. Its joint development promotes the mutual exchange about their companies and work processes, for which micro-technologists are employed. So they experience vividly the variety of companies in the micro- and nanotechnologies in Thuringia.

The poster can be used for different events for pupils and teachers in the context of occupational orientation. Attractiveness of this occupation is very good conveyed by this board.

Benefits/Prospect

The trainer obtains by this exploration task important information to what extent the apprentices have a clear idea of their vocational education and their future profession. Thus he obtains some insight into the motivation of the apprentices and can identify at what point there is still room for improvement.

At the same time the trainer upgrades his perception on the educating enterprises (including those, which educate for the first time).

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Project duration:
09/2008 – 09/2010

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BEST PRACTICE

MICRO-SYSTEM-TECHNOLOGY IN THE FI ELD OF MEDICINE

Abstract

Meanwhile, the micro-system-technology (MST) is an important part of the medical technology. However, it has been shown that the knowledge of the trainees is limited about the applications in this area. The implementation of this exploration task not only increases the knowledge of the apprentices, but also provide the teacher's new, useful knowledge.

Background

Whether in automotive industry, in mechanical engineering, finance, agriculture, military, pharmaceutical, communication and entertainment micro-system-technology is very popular.
An important field of application for microtechnology is the MST, which characterizes our modern life in many ways. MST companies are major employers for skilled micro-technologists. Therefore it is important to get apprentices early familiar with the practice and the possibilities of MST.

Against this background, the exploration task deals with a rapidly developing field of MST, which distinguishes itself by its human health serving products.

Objectives

The main objective of the task is to get to know the applications of micro-system-technology in the field of medicine.

This exploration task should be applied in an early phase of the vocational training. It helps to increase the identification of the apprentices with their profession by the use of illustrating the immediate practical significance. In this case it deals with the application field of medical technology. This area is characterized by particularly high dynamics of the use of MST. It points out in particular the opportunities and requirements for the MST from a technical and social perspective.

Results/Solutions

The results of the exploration can depict in a presentation on the base of following points:

- What technical trends micro-system-technology is tracking?
- What is a micro-system?
- What fields of application can be identified in medicine?
- Please name at least three examples.
- Please explain the functionality of some applications within medicine.
- What is a Lab-on-a-chip?

The results are documented in the form of a Power Point presentation that is to be designed by a very high proportion of visually interesting and vivid image displays. The presentation provides the basis for a debate between learners and teachers / trainers.

Benefits/Prospect

From the results of appropriate exploration tasks the trainer obtains a constantly updated overview of the application fields of MST. Furthermore the results encourage them to design future educational processes and, if necessary, for their own training of educational staff.

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PHOTOLITHOGRAPHY

Abstract

Photolithography is an frequently used lithography technology. The exploration task deals with the whole process of the procedure. The task can used as an important step to impart knowlege to apprentices with regard to this complex process. Furthermore, the results can give advices to the teacher on current development trends in the field of photolithography.

Background

Photolithography is a lithographic reproduction technique applying patterns to materials by light exposure. In semiconductor technology and other related areas, such as micro-systems- technology, it is used for patterning of masking. Thereby structure information from a so-called photomask is transferred into a photoresist. Getting to know this process is part of the training to become micro-technologist.

Objectives

The main objective of the exploration task is to get to know the workstations of the wafer production. The exploration task for apprentices of the 2nd year of apprenticeship of BWAW therefore was: Describe all workstations of the wafer production in the photolithography from the input to the final inspection. Work out current trends in photolithographic processes, which are related, for example, to the increasing miniaturization in micro-technology.

Results/Solutions

With this exploration task the apprentices get to know and understand one of the key processes in the field of semiconductor technology and their future professional field. The task can be used both at the beginning of the learning phase on photolithography and at the end. In the first case, it serves to exercise the independent development of a special subject-matter.

When used at the end of the corresponding learning period, the exploration task serves as a certain knowledge test as well. It is getting clear whether the apprentices comprehend and understand the complex process and are able to present the subject-matter compact and accurate. Here, above all, the competence of self-learning should be strengthened.

Benefits/Prospect

The result should be documented in the form of a poster. The stimulation for the apprentices to work it out this way has to be higher estimated than if the result is presented in the form of a text document. In addition, the poster can be applied in a variety of opportunities, for example as teaching material or for public relations in connection with occupational orientation and job-related information events.
The results of the exploration task may give advices to the teacher on current development trends in the highly complex field of photolithography, which should be conveyed in future measures of vocational education and further training.

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Manufacturing of Cantilever Beams using Micromachining Techniques

Abstract

The exploration task deal with the fabrication of cantilevers beam to be used in the realization of micro-sensors and micro-systems for different applications.
By carrying out the exploration task the trained employees gained knowledge different manufacturing techniques: bulk micro-machining, surface micromachining and front side etching.

Background

The attendees need a background in microelectronics or related disciplines as: physics, chemistry or mechanics.

Cantilevers based sensors can generate sensing platforms for a multitude of applications: mechanical, bio-chemical, gas detection, harvesting energy.

The purpose of the exploration tasks was to give to the employers basic knowledge about micromachining fabrication processes of cantileveres, main technological steps and specific applications

Participants had to work out a questionnaire and participate at an interview.

Objectives

The attendees participate at a power point presentation and a demonstration in the clean room of manufacturing a cantilever beam, using front side etching.

The presentation was focused on the operating modes of cantilevers, detection methods and technological steps for manufacturing of a cantilevers beam.

The techniques presented were: bulk micromachining, surface micromachining and front site etching.

Main objective: Evaluate the operational exploration task by means of the questionnaire filled in by the participants and trainers after the completion of the task.

Results/Solutions

Results of exploration task:

- acquiring knowledge about cantilevrs based sensors, operating principles, manufacturing techniques

- working out the tasks regarding spinning of photoresist; etching of different layers: Cr-Au, SiO_2; - etching in KOH solution in order to relize the cantilever beam

- discussion and worked out questionnaire

Benefits/Prospect

Acquiring knowledge about sensors and microsystems based on cantilevers.

Learn specific micromachining techniques for cantilever beam manufacturing.

Participate at a practical example performed in the clean room

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09/2008 - 09/2010

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Presentation of masks design using Clewin tool

Abstract

The exploration subject refers to a most common method to design the patterns of photomasks. The description of such masks is a key step during microproduct development.
By completing the exploration the trained employees gain knowledge about the principles, applications of Photo Mask and also learn to use Clewin layout editor.

Background

Most of micro-technologies are using masks in the fabrication process of micro-electronic devices or microsystems. It is important to know design rules and tolerances for a proper operation of photomasks using different pattering materials.
The aim of the exploration was to give the attendees an introduction to the field of a most common method of design the layout necessary for fabrication of photo-masks.
Also an other intend was to give information about CleWin program which is a layout editor designed to run under the operating systems for defining the masks.

Participants had to work out a questionnaire and participate at an interview.

Objectives

- By completing the task, attendees should participate at a power point presentation and a demonstration on basic Clewin usage in order to be able to:
  - describe what is a Mask and how to realize a Design Flow
  - understand and use the Clewin layout editor for realization of masks
  - realize the Exercises proposed: to design a set of masks in CleWin
- Main objective: Evaluate the operational exploration task by means of the questionnaire filled in by the participants and trainers after the completion of the task.

Results/Solutions

Results of exploration task:

- acquiring knowledge about the Mask design/ realisation and Clewin layout editor
- working out the tasks regarding the design of a set of masks in CleWin
- discussion and worked out questionnaire

Benefits/Prospect

Acquiring knowledge on the utilization and applications of Clewin layout editor and about the most common method of designing a set of masks.

Knowledge about how to use specific design rules, alignment marks, minimum dimen-sions and tolerances.

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Project duration: 09/2008 - 09/2010

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GOOD PRACTICE

Physical Vapor Deposition Techniques (PVD) of thin films

Abstract

Thin film deposition of metallic, insulating, conductive and dielectric materials plays an important role in a large number of manu-facturing, production and research applications

The Exploration presen-ted Physical Vapor Deposition (PVD) techniques: Evaporation by resistance heating technique; Evaporation by Electron Beam technique; DC Sputtering technique

Background

The attendees need a background in micro-electronics, physics , or technological processing

The exploration will present:

- Basic principle of the Physical Vapor Deposition (PVD) methods
- The main available material sources and substrates to be used in PVD

The main scope of the exploration tasks was to give to the employers basic knowledge about the main Physical Vapor Deposition (PVD) methods

Participants had to fill a questionnaire and to participate at an interview.

Objectives

The attendees participate at a power point presen-tation regarding the subject.

The presentation has the purpose to initiate in PVD equipment and typical operational instructions for film deposition.

There were presented different techniques: equipments, materials to be used as sources and substrates, process flow, process characteristics, different applications

Main objective: Evaluate the operational exploration task by means of the questionnaire filled in by the participants and trainers after the completion of the task.

Results/Solutions

Results of exploration task:

- acquiring knowledge about Physical Vapor Deposition (PVD) techniques: Evaporation by resistance heating technique; Evaporation by Electron Beam technique; DC Sputtering technique

- discussion and worked out questionnaire

Benefits/Prospect

Acquiring knowledge about different methods for PVD.

► Available films deposited by various methods: substrates and film materials

►Deposition equipment available in various methods

►Specifique operational instruct-tions

Initiating in PVD equipment and typical operational instructions for film deposition.

Information about the field of applications.

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Measuring surface topography in submicron range with Atomic Force Microscopy

Abstract

The exploration subject refers to high resolution characterization and measurement of surface morphology with the Atomic Force Microscopy (AFM) technique.
By completing the exploration the trained employees gain insight into the principles, basic usage and applications of AFM.

Background

With decreasing feature size in micro and nanotechnologies, there is an imperative need for characterizing and measuring surface features with adequate high resolution.
The aim of the exploration was to give the attendees an introduction to the field of high resolution surface characterization by Atomic Force Microscopy (AFM).
AFM, a member of Scanning Probe Microscopy (SPM) techniques, is a branch of microscopy that forms high-resolution images of surface topography by monitoring the behavior of an ultrasharp physical probe as it moves in a raster pattern in contact with or in close proximity to the specimen surface.
Participants had to work out a questionnaire and participate at an interview.

Objectives

- By completing the task, attendees should watch a demonstration on basic AFM usage and should be able to:
- describe the basic components and the operation principles of an AFM
- compare AFM method with other microscopic techniques from the point of view of benefits and drawbacks
- describe the main steps for acquiring and processing an image

- Main objective: Evaluate the operational exploration task by means of the questionnaire filled in by the participants and trainers after the completion of the task.

Results/Solutions

Results of exploration task:
- acquiring knowledge about the Atomic Force Microscopy (AFM)
- working out the tasks regarding the use of AFM
- discussion and worked out questionnaire

Benefits/Prospect

- Acquiring knowledge on the use and applications of Atomic Force Microscopy (AFM)

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Project duration: 09/2008 - 09/2010

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Exploring COVENTORWARE Software Tool for Simulations of Microsystems

Abstract

Topic was to get knowledge about CoventorWare software tool and to learn the Finite Element Method used for simulations of Microsystems. Participants of a course had to work out and to realize the requests of the exploration task about simulations in the field of Microsystems.

Background

Documentation and books about CoventorWare software were provided for the participants at the exploration task. One objective was to introduce the participants in the Finite Element Method which is one of the most used methods for modeling and simulation of microsystems in order to observe the physical behavior and effects.
Design, Modeling and Simulation of a microsystem is a necessary condition before proceeding to realize the masks and to fabricate the device.
Objective of the exploration is to increase the competencies of apprentices about CoventorWare software tool which is an integrated suite of software tools dedicated for design, modeling and simulation of micro-electro-mecanichal systems (MEMS) and microfluidics devices.

Participants had to work out a questionnaire and participate at an interview.

Objectives

Achieved results should help all participants to understand better the utility of using Finite Element Method and CoventorWare software tool for Design, Modeling and Simulation of microsystems.
All the participants had to understand the capabilities and advantages of the CoventorWare software tool and the advantages of a simulations in order to observe the physical behavior and the effects.
For this purpose participants had to complete the tasks, to work out a questionnaire as utility of exploration task.
After completion of exploration task it had to be realised by participants.

Results/Solutions

Results of exploration task:
-acquire knowledge about the structure and the modules of the software
- work out the tasks regarding the use of CoventorWare software tool
- discussion and worked out questionnaire
- first experience to deal with the software for simulation

Benefits/Prospect

- Basis for acquiring knowledge to use a software (CoventorWare) and the finite element mehod for design, modeling and simulation of a microsystem
- Development of knowledge in the 3-D simulation domain and the possibilities in order to observe the physical behavior of a microsystem and to design a microstructure (device)

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09/2008 - 09/2010

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GOOD PRACTICE

EXPLORING Electron Beam Lithography Training

Abstract

The exploration task (ET) methodology is seen as an approach to exchange knowledge about Electron Beam Lithography (EBL), a specialized technique for creating the extremely fine patterns required by the modern electronics industry. In this ET were involved INESC MN researchers, cleanroom engineers, master and PhD students or industrial interns.

Background

Research and training in the field of nano and microtechnology (NMT) requires innovating methods in order to register and exchange of knowledge. In the specific case of EBL process, some procedures need to be taken, as develop the training in a clean room environment and consists of a 5-step process. SO, there are special requirements in order to assuring that all the educational and technical staff involved in this process develop transversal competences.

Objectives

The main objective is understand the EBL technology that uses a focused electron beam with a very small spot size to directly write on a compatible resist, providing a pattern resolution from submicron to a few nanometers. This overcomes the limitation of the standard optical lithography due to diffraction.

The tools used during the learning process are:

- RAITH 150, an electron beam lithography ad scan electron beam system;
- SVG Resist spin / develop track system, a track system to spin coat and develop resist;
- Vapor priming oven (YES), allows the surface treatment of silicon prior to resist spin coating;
- Optical microscope (Olympus), a visual observation of photoresist pattern after exposure and develop

The materials used are:

- Electron Beam Resist (negative, AR-7520.18)
- Developer (AR 300-47)

The software used is:

- RAITH software (Version 4, SP 10)

Results/Solutions

This training will allow the comprehension of the main steps of an electron beam lithography process:

1. The alignment of the sample (namely the overlay of an exposure with a layer defined previously by optical lithography);
2. The focus and stigmation correction of an electron beam;
3. The final imaging of the samples will give training on scanning electron beam manipulation.

Benefits/Prospect

The exploration task allowed identified the follows problems and improvement actions about the learning process. The problems identified are:

- Optimization of the exposure parameters to achieve the nominal dimensions on mask;
- Proximity effect on masks with high density of features;
- Possible misalignment of features for accuracy lower than 100 nm.

Future improvement actions suggested are:

- Reoptimize exposure process parameters to obtain critical dimension compliance;
- Mask design optimization for proximity effect correction and minimize misalignment problems.

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EXPLORING Optical Lithography for Microfabrication of Sensors and Microsystems Training

Abstract

Topic was to develop training to get knowledge and technical competences, using exploration task methodology, about optical lithography. Actors involved in the learning process are INESC MN researchers, cleanroom engineers, master and PhD students or industrial interns.

Background

The process of optical lithography uses a direct-write laser system (Heidelberg Instruments-DWLii). The process involves design of pattern, using design software such as AutoCAD, transfer of pattern to photoresist in a clean room environment and visual inspection of the structures via optical microscopy and scanning electron microscopy. With the method of operational exploration task, all the learning process was registered and exchange between educational and technical team.

Objectives

The main objective is understand the optical lithography current method utilizing a direct-write laser system has the advantage over standard optical lithography in that it allows a quick turnaround from device design to proof of concept and potentially small series prototyping.

The tools used during the learning process are:

- DWLii (Heidelberg Instruments), a laser direct write lithography system;
- SVG Resist spin / develop track system to spin coat and develop photoresist;
- Vapor priming oven (YES), allows the surface treatment of silicon prior to resist spin coating;
- Optical microscope (Olympus), a visual observation of photoresist pattern after exposure and develop;
- Scanning electron microscope (Hitachi), for observation of resist profile

The materials used are:

- Photoresist (positive, g-line)
- Developer

The software used is:

- AutoCAD

Results/Solutions

Training will allow the student to design and realize patterns in photoresist down to dimensions of 1 micron. This is one of the main steps process in microfabrication. The training will first teach the fundamentals of optical lithography and how the process works. Then the student will use AutoCAD to design a pattern that will then be transferred to photoresist using the direct-write laser lithography system. The final result will be the imaging of the pattern using optical lithography and the imaging of the resist profile using SEM.

Benefits/Prospect

The exploration task allowed identified the follows problems and improvement actions about the learning process. The problems identified are:

- Critical dimensions of lithographically defined structures not according to design;
- The balances between the times spend with theoretical instruction and practical training needs to be optimized.

Future improvement actions suggested are:

- Reoptimize exposure process parameters to obtain critical dimension compliance.
- Receive feedback from trainees to improve the ratio of theoretical to practical training in exploration tasks.

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BEST PRACTICE

TECHNOLOGY OF STENCIL MANUFACTURING

Abstract

Deposition of solder paste by screen-printing is widely used method of the deposition in the industry. The screens are always manufactured according to requirement of company producing electronics. So, there is often deficit of knowledge about manufacturing of the stencils in spite of the fact that stencils play important role in printing quality.

Background

A lot of factors affect solder paste printing quality and consequently quality of solder joints. One of these factors is the stencil.

The stencils can be manufactured by various methods and from various materials (the materials are based on metal or plastic). The technology of the manufacturing and the material of stencil have their benefits and drawbacks and affect the quality of solder paste deposition.

There is a group of smaller companies producing electronics which do not have necessary equipment for stencil manufacturing, so they always order stencils from the manufacturing company. There is a expectation, that they do not have all necessary experience and knowledge about all available technologies of stencil manufacturing, which has impact on printing quality and relation between price and quality.

Objectives

The purpose is to familiarize participants (employees, teachers from another institutions, etc.) with the technology and processes of stencils manufacturing from view of the printing quality and consequently help them to make the choice of appropriate stencil manufacturer. There is a goal to transfer knowledge from companies oriented on stencil manufacturing to employees of another companies, who are not experienced with the stencil manufacturing. In the case of other educational institutions main purpose is to extend a view in progressive technology, so they can educate new potential employees with closer knowledge of practice.

Results/Solutions

The recherché in the form of presentation about the stencil manufacturing was suited for education and training process. The information was transferred by training course that consists of class lecture, laboratory exercise, discussion about topic and exchanging of experience between participants. The quality of training was evaluated by feedback of participants.

Positively was evaluated content of the course, because it introduced not so widely used methods of precise stencils manufacturing (electroformed stencils) and low-cost material (plastic) for stencils, too.

Benefits/Prospect

The knowledge from teaching/research institution (like TUKE) has more theoretical background whereas producing companies knowledge is more practical. The exchange of this knowledge is very useful for both types of institutions. All participants consider this exchange as well as combination of class/laboratory educational process very useful.

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BEST PRACTICE

VAPOUR PHASE SOLDERING FOR MICROELECTRONIC CIRCUITS SOLDERING

Abstract

There are several methods of soldering in a batch process. All methods have some benefits and drawbacks. Vapour phase soldering is relatively new method of soldering so it is not so familiar in smaller companies. But this method offers many interesting benefits and so there is good reason to give basic information about it.

Background

Vapour phase soldering (also called condensation soldering) is one of soldering technologies for microelectronic circuit soldering. In recent years the soldering technologies had to modify for lead-free solder pastes. The conditions, used materials, thermal profile etc. had to adapt for new pastes to comply with requirements on quality and reliability. Compared to other soldering methods, the vapour phase soldering offers big advantages in heat transfer without risk of overheating and provides inert atmosphere. All this assure minimal risk of low quality joint.
The Department of Technologies in Electronics, TUKE has much experience with its own developed equipment for vapour phase soldering. On the other side, the smaller companies have lack or no experience with this method of soldering.

Objectives

The purpose is to familiarize participants (employees, teachers of another institutions, students, etc.) with the progressive method of soldering, namely "Vapour phase soldering" (VPS). The smaller companies or other teachers absorb the knowledge about basic principles of VPS soldering, its comparison with other soldering methods and its advantages and disadvantages.
Important part of objectives is transferring our own experience with VPS and its impact on joint quality compared to other soldering methods. New information can help companies to evaluate benefits of VPS and eventually transfer this technology to their production process.

Results/Solutions

The PowerPoint presentation concerning the "Vapor phase soldering" was worked-out. The knowledge was transferred by training course that consists from class lecture, laboratory exercise. The laboratory exercise included demonstration of VPS equipment developed at our department and discussion about our experience with VPS with participants. The participants discussed their experience about reflow process used in their companies. The quality of training was evaluated by feedback of participants.

Benefits/Prospect

All participants consider new information about VPS as well as exchange information about VPS and different methods of soldering (VPS and their own method of reflow soldering) very useful. They recognize combination of class/laboratory educational process and practical demonstration of VPS soldering.

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Project information

ComEd – Development of educational staff by integrating operational tasks into measures of vocational training and further education

Project duration: 09/2008 – 09/2010

www.comed-project.eu

Education and Culture DG

Lifelong Learning Programme