Design & Development of Metallographic Processing Laboratory Set up

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Abstract— Metal polishing is an extremely ancient technology that has long been used to make beautiful objects art as well as utilitarian objects. However, within the context of modern microelectronics it is a much more narrowly defined technology that is invariably used to fabricate "damascene" structures. The origin of this terminology is obscure, however for integrated circuit fabrication damascene means microscopic, inlaid metal features that serve as "wiring" to connect individual electronic components, e.g., transistors, previously formed in an underlying semiconductor substrate (usually a single crystal silicon wafer). Of course, the overall objective is fabrication of functional devices such as microprocessors or memories. Naturally, to serve this purpose metal wiring must be inlaid in some insulating material (typically silica based glass) with appropriate provision made for interconnections between wires and the substrate and between the wires themselves.

Key words: Metallographic Processing Laboratory, Polishing

I. INTRODUCTION

Polishing and buffing are finishing processes for smoothing a workspace's surface using an abrasive and a work wheel or a leather strop. Technically polishing refers to processes that use an abrasive and a work wheel or a leather strop. Technically polishing refers to processes that use an abrasive that is glued to the work wheel, while buffing uses a loose abrasive applies to work wheel. Polishing is a more aggressive process while buffing is less harsh, which leads to a smoother, brighter finish. A common misconception is that a polished surface has a mirror bright finish, however most mirror bright finishes are actually buffed Polishing is often used to enhance the appearance of an item, prevent contamination of instruments, remove oxidation, create a reflective surface, or prevent corrosion in pipes. In metallographic and metallurgy, polishing is used to create a flat defect free surface for examination of a metals microstructure under a microscope. The removal of oxidization (tarnish) from metal objects is accomplished using a metal polish or remover this is also called polishing. To prevent further unwanted oxidization polished metal surfaces may be coated with wax, oil or lacquer. This is of particular concern for copper alloy products such as brass and bronze metallographic or microscopy consists of the microscopic study of the structural characteristic of material or an alloy. The microscope is thus the most important tool of a metallurgist from both, scientific & technical study point view. It is possible to determine grain size, Size, shape & distribution of various phases& inclusions have a great effect on the mechanical properties of metal. The microstructure will reveal the mechanical & thermal treatment of the metal & it may be possible to predict its behavior under a given set of conditions. Experience had indicated the success in microscopic study depends upon the care taken in the preparation of specimen. The most expensive microscope will not reveal the structure of a specimen that has been poorly prepared. The procedure to be followed in the preparation of a specimen is comparatively simple & involves a technique which is developed only after constant practice. The ultimate objective is to produce a flat, scratch free, mirror like surface. The steps involved or prepare a metallographic specimen properly are explained.

There four types of polishing

1) Grinding: After cutting the specimen is ground by holding is perpendicular to the grinding marks
2) Dry polishing: Emery papers made up of SiC, Al2O3, and B2N are used for dry polishing.
3) Wet polishing: A dry polished specimen is now polished further by wet polishing. It consist of a disc polishing machine having a rotating disc whose speed can be varied a velvet cloth is fixed on this rotating disc.
4) Etching: The purpose of etching is to make the many structural characteristic of the metal or alloy visible.

II. LITERATURE REVIEW

Donald C. Zipperian.[1] He has published paper on metallographic specimen preparation Metallographic is the study of a materials microstructure. Analysis of a materials microstructure aids in determining if the material has been processed correctly and is therefore a critical step for determining product reliability and for determining why a material failed. The basic steps for proper metallographic specimen preparation include: documentation, sectioning and cutting, mounting, planar grinding, rough polishing, final polishing, etching, microscopic analysis, and hardness test. Micro structural analysis is extremely important in today's world where metals, ceramics, polymers, and composites are used to improve our everyday lives by insuring safety and reliability in the products that we use. In order, to correctly analyze these microstructures, proper specimen preparation is required to eliminate preparation induced micro structural artifacts. By knowing the physical properties of the material such as hardness, recrystallization temperature, fracture toughness; an appropriate specimen preparation procedure can be developed. In general, minimizing the damage early in the micro structural preparation stage by choosing the correct abrasive, lubricant, and equipment parameters, the steps required to highlight the representative materials microstructure obtained by following the basic preparation guidelines outlined in this paper. Planar Grinding - or course grinding is required to plenary the specimen and to reduce the damage created by sectioning. The planar grinding step is accomplished by decreasing the abrasive grit/ particle size sequentially to obtain surface finishes that are ready for polishing. Care must be taken to avoid being too abrasive in this step, and actually creating greater specimen damage than produced

during cutting (this is especially true for very brittle materials such as silicon). The machine parameters, which effect the preparation of metallographic specimens, include grinding/polishing pressure, relative velocity distribution, and the direction of grinding/polishing.

R.Sedlacek. J.Jorgenisen. [2] He has conducted experiments on processing of ceramics – surface finish studies. Expanded ring test was used to determine the tensile strength of high purity, dense alumina. The test materials were prepared in five different nominal grain sizes ranging from 10 to 50μm. The blanks were diamond ground to final dimensions by a technique developed earlier in the program. It was found that in grinding this material extensive damage took place which had not been observed in any other alumina body ground under identical conditions. The only difference in strength was found between groups of specimens having grain sizes equal to or smaller than 30μm. The author concluded that the strength of material depends upon the surface finish of the material. M. Komaraiah at conducted experiments on different work materials –glass, porcelain, ferrite, alumina using various tools- titanium, stainless steel. The surface roughness of the different work pieces were analyzed with respect to hardness of the tool material and abrasive used.

C. Y. Wang, X. Wei, and H. Yuan [3] conducted experiments on polishing of ceramics Tests were carried out in a special manual grinding machine for ceramic tiles. Two grinding wheels were fixed in the grinding disc that was equipped to the grinding machine. The diameter of grinding disc was 255 mm. The rotating speed of the grinding disc was 580 rpm. The grinding and polishing wheels are isosceles trapezoid with surface area 31.5 cm2 (the upper edge: 2 cm, base edge: 5 cm, height: 9 cm). The pressure was adjusted by means of the load on the handle for different grinding procedures. A zigzag path was used as the moving trace for the grinding disc. To maintain flatness and edge of the ceramic tiles, at least one third of the tile must be under the grinding disc. During the grinding process, sufficient water was poured to both cool and wash the grinding wheels and the tiles. Surface reflection glossiness and surface roughness of the ceramic tiles and the wear of grinding wheels were measured. The performance of grinding and polishing wheels will affect its life and the surface quality of ceramic tiles, the optimization of the combination of grinding wheels and polishing wheels for all the steps will shorten machining time and improve surface quality. Optimization must be determined for each ceramics tiles.

V. Kumar [4] Used design of experiment and regression approach for the statistical analysis of the ultrasonic machining of Glass. The response of the material removal rate of the glass was identified with the range of different parameters such as power rating, abrasive type, abrasive size, and slurry concentration. It was found that the grit size was most vital parameter and slurry concentration was the least significant parameter and having minimum contribution to the MRR It was conjointly ascertained that the carbide have additional impact on MRR as compared to the mixture of aluminum oxide + silicon carbide. The 60% power rating resulted in better MRR as compared to 20% and 40% slurry concentration. This might result to it additional power rating could lead to additional erosion of

Literature Review on Optimization of Finishing Operation in a Ceramic Material the work. The grit size of 280 resulted in more MRR as compared to the 400 and 600 grit size.

Sunil Jha and V. K. Jain [5] used nanotechnology to measure surface roughness of ceramics by various operations and he concluded that non-conventional method for super finishing is better than conventional method but non-conventional method is costlier than conventional method. R. Cebalo, D. Bajic and B. Bilic [6] conducted experiment on optimization of the super finishing process. In this paper impact factors on surface roughness are determined. According to the factors test plan and regression analysis, extend equation for mean arithmetical roughness is given. In other to get minimum values of the surface roughness, optimization of the mathematical model is done and optimal values of the examined factors are determined.

Darlene & William Radichel Herbarium [6]:- He has paper on Specimen mounting papers come in several sizes. In the U.S., 11.5 x 16.5 is a common size. A good specimen will be pressed so that it fits comfortably within a 10.5 x 15.5 area. This allows a protective 1/2 margin around the plant. When plant parts are glued right up the edge of the paper, they get broken or shredded too easily. If you are collecting for a herbarium, make sure to find out the size of its mounting paper.

There must also be room on the specimen for a label, which is usually placed in the lower right hand corner of the paper. This is the place most people will reach for when taking specimens from their cabinets. Squeezing the label is better than squeezing any part of the plant. A common size for labels is 4-1/4 x 5-1/2 or smaller. When arranging a plant to be pressed, try to leave a corner open for the label. Only relatively small plants will fit in a 10 x 15 area. Botanists sharply bend (not cut!) stems to form a V or zigzag pattern. Sometimes a large plant will have to be glued onto two or more.

A. Mounting papers

When this is the case, each "sheet" will receive the same collection number and label information. Sheets will also clearly be marked "1 of 2" and "2 of 2" or as necessary, depending on the number of sheets that specimen filled. As you collect and press, you will be able to anticipate which specimens will require more than one sheet. Label your newspaper folders accordingly.

B. Objective

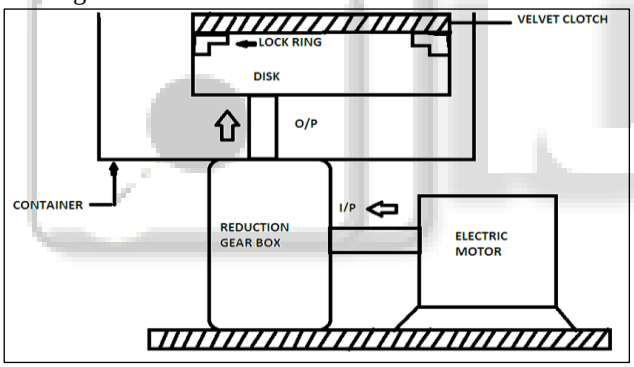
- To demonstrate technique of "Preparation of specimen for metallographic and to get knowledge of mounting process for this technique."
- To learn and to gain experience in preparation of metallographic specimen'
- To examine and analyze the microstructures of metals and metallic alloy.

C. Construction

Requirement of construction Requirements of design come out from a market research of polishing machine´s

production. One of the most important requirements is a force measurement of pushing a polishing wheel on the polishing surface. Other requirements include a regulation of a spindle speed, guns for spraying polishing emulsions, dispenser for solid pastes bar feeder or measuring of a wheel´s diameter. At the request of the company ABB servo., has been designed an automatically cleaner of sediment bar feeder on the polishing wheel, which makes little burls on the surface of the polishing wheel. Meantime, this wheel cleaning is realized on machines by human hand only. Getting of automatically cleaning will lead to reduce a human impact during machine's working. Construction of polishing machine the designed polishing machine is shown at fig. Consisting from two main components of a base and a machine table which is attached on gear box ways. This Unifi solution of a moving table of a polishing machine helps regulate a decrease of wearing off the polishing wheel during polishing procedures. This robotic polishing machine can regulated the size of a contact force and can prevent a collision with a polishing surface. The engine situated into a base of polishing machine cause of a decreasing weight of machine table, transfers a torque moment per belt driver to the shaft. There are attached a polishing wheel on both sides of the shaft. Two polishing wheels are used because of usual polishing in two operations, during first operation is used greasier emulsion with coarser grains the second operation the emulsion is drier with finer grains for the greater shine.

Working:-



- The laboratory set up consists of 3 units' electric motor, reduction gear box & rotating disc.
- The electric motor & electric gear box are bought component & rotating disc is an assembly
- The assembly is manufactures in machine shop by turning, milling, welding, & finishing process.
- A previously dry polished is that on rotating disc contains velvet cloth fitted on its Aluminum oxide powder & water slurry is used to polish the specimen at about 400 rpm.
- The sample is cleaned with water& then subjected to etching process.
- All manufacture & process required for manufacturing & assembly are available in college workshop.
- The testing will be done after etching under metallurgical microscope in college metallurgical lab.
- Various ferrous & nonferrous samples can polish by this set up.

D. Advantages

1) Gives a natural appearance with a high gloss and sheen Produces a relatively durable Very durable, long lasting finish.
2) Never requires stripping.
3) Will remove all scratches.
4) Works well on marble and granite.

E. Disadvantages

1) A messy process, requiring additional work to clean up.
2) If oxalic acid is included in the powder, it can cause etching or blistering of marble and limestone depending on the skill of the person using.
3) Requires equipment (i.e., a floor machine, wet vac, mop, mop bucket, etc.)

III. Conclusion

Availability of cleaning materials and polishes .As a consumer it is possible to find products to clean and polish metal objects in convenience stores as well as specialist shops. The supply seems to be largest within cleaning materials and polishes. For silver in the specialist shops. Internet searches and visits to the shops gave the same picture of the availability of products on the market. Therefore, it is evaluated that the mapping has covered the market.

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