Chapter 12
Surface Engineering for Coating: A Smart Technique

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ABSTRACT

Surface engineering includes augmentation of intrinsic properties of the boundary of the component, which isolates the continuum from surroundings known as the surface. Two main purposes of surface engineering encapsulate primarily the hardness of the surface for enhanced wear resistance and also to poise up with inter-surface frictional behavior. Today, there are many different surface engineering techniques available: starting from vacuum to atmospheric pressure, wet to dry, simple to sophisticated, and low-cost to high-cost to obtain the required purposeful distinctiveness of material. Most methods used today are dry and thus environmentally sound. This chapter describes various types of coatings over materials to get an overall idea of the technique keeping prime focus on graduate and undergraduate students.

1. INTRODUCTION:

Surface engineering for coating is a smart technique. Surface engineering is a high-throughput technology encompasses the physical (macro) and chemical (micro) aspects for better electrical, magnetic, electronics, thermal and optical properties. Surface being a membrane plays a crucial role pertinent to permeability factors like diffusion, osmosis, reverse osmosis, absorption and adsorption. Surface coating technology is an interlayer technology which eventually protects the substances without affecting the properties of

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neighboring layers. To ascertain a good tribological response, surface integrity plays a great role when it is substrated with the concepts of surface engineering. Surfaces which gets germinated owing to the proper directive of surface engineering, deals both the interfaces of the surface with the environment and also with the substrate. It is well-known from long back in different parts of society. The prima facie objective of surface coating is to amend and emphasize more on the surface functions rather to reform the composition of the material of concern. Literature survey reveals the (Pfeifer, 2009) mention of thin film coating technology as adopted by artists and craftsmen more than two thousand years ago without any knowledge about the chemico-physical processes involved in it. Fire gilding, silvering are the longstanding mercury-based processes used to coat surface of less precious substrates with thin layers of gold or silver. Ancient civilization systematically manipulated these metals to create functional and decorative artistic objects (Maria Ingo et al., 2013). Even before, in different ancient civilization, surface coating techniques found in other form such as paints prepared from iron oxide, chalk or charcoal used either with the fingertips or with the tips of soft twigs of brushes. People also used to paint the rock walls of their caves with pictures of their pets, other animals and their family fellows (Gooch, 2002).

Later they started to use natural resins and wax for coating. Artists used lacquers on dried oils to protect their paintings. Interestingly ancient Egyptian scientists developed a fine coating technology which is similar with nanotechnology. Thereafter several theories tried to establish nanotechnology as a re-innovated technology. At the present time, there are several thousand of coating techniques applied to simple systems based on one or two coating steps to sophisticated systems based on multi layers and complicated instruments. Conversely, most are not environment friendly and, in many cases, can't fulfill the demands of the manufacturing industries or of society. This is the driving force to conduct an extensive research and development in coatings science and surface technology.

2. BACKGROUND AND MAIN THEME

From the starting of our civilization, people made many things to fulfill their daily requirements. Those will be stronger and harder if made by hard materials. For specific applications mechanical parts and structures are designed. It is very necessary to choose some extensive material rather than fabrication of these parts. These limitations consist of body materials, mechanical behavior (tension, compression, yield, torsion, fatigue, bending, creep etc.), desired functionality (friction, hydrophobicity, wear resistance etc.), thermal behavior (expansion and thermal conductivity), electrical conductivity, dynamic load bearing (vibrations, high-speed rotation etc.), and corrosion resistance. Some important aspects also to be kept in mind; such as availability, cost, safety, and toxicity of materials. All these factors play an important role to manufacture mechanical parts and structures. Selection of materials is the important key to provide all protection purposes. To protect all the parts, a successful coating technique need to chose, including metals, ceramics, and polymers, that can form a protective layer (DeMasi-Marcin & Gupta, 1994). However, coating processes and material properties may generate complexity to choose the best composition of the deposited layer. Even though coating processes are obliging to afford the profits mentioned above, still they undergo some disadvantages which worsen their trustworthiness. Among these, negative thermal effects, disparaging thermal effects (distortion, crack, delamination, etc.), damaging effects of atmospheric protection (penetration of inclusions and contaminations into the substrate) and coating materials' properties (melting point, availability in different forms of foil, powder, rods, biocompatibility, etc.) are the most vital ones to be considered. (DeMasi-Marcin & Gupta, 1994;

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