# ABSTRACT

Engineering materials must have some specific characteristics and those characteristics are important in selecting material for specific applications related with material structure and life-time. It is difficult to find that all these features especially mechanical and surface properties in a single material. So, the solution is found by increasing the strength of bulk material and increasing wear and corrosion resistance of the surface. Therefore, engineering materials are selected from cheaper materials providing needed structural features and other surface characteristics are obtained from coatings. Friction and wear of the sliding components in an automobile are caused an increase in both fuel consumption and emission. Many engine components involved with sliding contact are all susceptible to scuffing failure at some points during their operating period. Therefore, it is important to evaluate the effects of various surface coatings on the tribological characteristics of the automobile parts. In this study, the influence of heat treatment on the micro structure, influence of micro structure on the coatings and the wear and corrosion protective properties three types of vacuum arc evaporation PVD coatings have investigated. Further the relation between wear and corrosion protective properties are also investigated. In addition PVD coatings are found to be harder and more corrosion resistant than coatings applied by the electroplating process. Most PVD coatings have high temperature, good impact strength, excellent abrasion resistance and durable so that additional protective topcoats are almost never necessary. In addition PVD coatings are more environmental friendly than traditional coating methods like electroplating and painting.

Heat treatments are one of the essential processes in obtaining the desirable characteristic of metal. It is mainly used to alter the physical and mechanical properties of metal without major changes in its physical shape. Annealing is one of the important heat treatment methods which decreases the chance of formation of cracks during cold working since, the mechanical stresses of the material are released during annealing.Transition metal nitrides have been extensively used in industry as protective hard coatings because of their hardness and wear resistance. Among these coatings, the most popular one is titanium nitride (TiN), which possesses a high hardness. While the actual applications of Diamond Like Carbide (DLC) coatings in the automotive industry are often under lubricated contacts, the tribological tests carried out without lubricants and in ambient air or controlled atmospheres allow the investigation of the physical mechanisms that affect self-lubrication effects. The Partially Stabilized Zirconia (PSZ) coating is deposited by using Atmospheric Plasma Spraying (APS). The Plasma Spray Process is basically the spraying of molten or heat softened material onto a surface to provide a coating. Material in the form of powder is injected into a very high temperature plasma flame, where it is rapidly heated and accelerated to a high velocity.

The effect of heat treatment on micro structure of SS 304L was studied. Further the percentage of wear resistance of the TiN, DLC and PSZ coating on SS304L and Al 1100 were studied by pin-on disc method. The corrosion resistance of the samples were compared with the uncoated samples using Gamry reference 600 potentiostate in 3.5% NaCl medium. Three electrode set ups was used to analyse the corrosion behaviour, in which the coated sample, calomel electrode and platinum foil acts as the working electrode, reference electrode and counter electrode respectively.

Aluminium 1100 was annealed at three different temperatures (150, 250 and 350 °C). It is found that the aluminium 1100 alloy annealed at 250 °C has better grain size and hence better bonding strength when coated with three different thin films like TiN, DLC and partially stabilized Zirconia. Stainless steel 304 was annealed at three different temperatures (700, 800 and 900 °C) and it is found that the stainless steel 304L annealed at 800 °C develops cube texture with some rolling texture which increases the hardening and adherence of substrate material with the three coating methods TiN, DLC and PSZ.

The percentage of wear resistance of TiN, DLC and PSZ coatings on SS304L were found to be higher by 28%, 39% and 47% respectively, compared to uncoated SS 304L. Similarly the percentage of wear resistance of TiN, DLC and PSZ coated on Al 1100 were 30%, 38% and 46% respectively, compared to uncoated Al 1100.

The corrosion resistance of TiN coated SS 304L with 3.5% NaCl medium was found to be 62% more in comparison with uncoated SS304L, Where as the corrosion resistance of the same coating increased to 94% more on Al1100 alloys. DLC coatings show better corrosion resistance (88% more on SS304L and 97% more on Al 1100 alloys) than TiN in 3.5% NaCl medium. PSZ shows the superior corrosion resistance (98% more on SS304L and 99% more on Al 1100 alloys) than the other two coatings (TiN and DLC) in 3.5% NaCl medium. This is due to the uniform coating of PSZ, chemical inertness, higher hardness and very high chemical stability in the chloride environment.