

# Fe-C-Si ternary composite coating on CP-titanium and its tribological properties

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**Abstract.** This study focused on the development of ternary composite coating through incorporation of Fe-C-Si ternary powder mixtures on CP-Ti substrate and characterizes the microstructure, hardness and wears behavior in presence of Jatropha oil. In this work, the surface of commercial purity titanium (CP-Ti) was modified using a tungsten inert gas (TIG) surface melting technique. The wear behavior of coated CP-titanium was performed using pin-on-disk machine. The results showed that the melt track has dendritic microstructure which was homogenously distributed throughout the melt pool. This Fe-C-Si ternary composite coating enhanced the surface hardness of CP-Ti significantly from 175 HV for the untreated substrate to ~800 HV for the Fe-C-Si coated CP-Ti due to the formation of intermetallic compounds.. The wear results showed that less wear volume loss was observed on the composite coated CP-Ti in presence of Jatropha-biodiesel compared to uncoated CP-Ti. The achievement of this hard Fe-C-Si composite coating on the surface of CP-Ti can broadened new prospect for many engineering applications that use biodiesel under different tribological variables.

## 1. Introduction

Titanium is one of the few allotropic metals that exist in two different crystallographic forms. At room temperature, it has a close-packed hexagonal structure, designated as the alpha phase whereas, at around 884 °C, the alpha phase transforms into a body-centred cubic structure, known as beta phase which is stable up to titanium's melting point of 1677 °C. Alloying elements promote the formation of one or the other of the two phases. Carbon, for example, stabilizes the alpha phase which means it raises the alpha to the beta transformation temperature. Iron, copper, chromium and vanadium are beta stabilizer which lowers the transformation temperature, therefore allowing the beta phase to remain stable at lower temperatures, and even at room temperature. Thus, titanium's mechanical properties are closely related to these allotropic phases. For example, the beta phase will be much stronger but more brittle than alpha phase. Commercially pure titanium (CP-Ti) is unalloyed titanium characterized by an alpha phase hexagonal close-packed crystal structure. Commercially pure titanium is over

