

## Sustainable Approach to Fabricate Titanium Nitride Film on Steel Substrate by Using Automotive Plastics Waste

**Authors :** Songyan Yin, Ravindra Rajarao, Veena Sahajwalla

**Abstract :** Automotive plastics waste (widely known as auto-fluff or ASR) is a complicated mixture of various plastics incorporated with a wide range of additives and fillers like titanium dioxide, magnesium oxide, and silicon dioxide. Automotive plastics waste is difficult to recycle and its landfilling poses the significant threat to the environment. In this study, a sustainable technology to fabricate protective nanoscale TiN thin film on a steel substrate surface by using automotive waste plastics as titanium and carbon resources is suggested. When heated automotive plastics waste with steel at elevated temperature in a nitrogen atmosphere, titanium dioxide contented in ASR undergo carbothermal reduction and nitridation reactions on the surface of the steel substrate forming a nanoscale thin film of titanium nitride on the steel surface. The synthesis of TiN film on steel substrate under this technology was confirmed by X-ray photoelectron spectrometer, high resolution X-ray diffraction, field emission scanning electron microscope, a high resolution transmission electron microscope fitted with energy dispersive X-ray spectroscopy, and inductively coupled plasma mass spectrometry techniques. This sustainably fabricated TiN film was verified of dense, well crystallized and could provide good oxidation resistance to the steel substrate. This sustainable fabrication technology is maneuverable, reproducible and of great economic and environmental benefit. It not only reduces the fabrication cost of TiN coating on steel surface, but also provides a sustainable environmental solution to recycling automotive plastics waste. Moreover, high value copper droplets and char residues were also extracted from this unique fabrication process.

**Keywords :** automotive plastics waste, carbothermal reduction and nitridation, sustainable, TiN film

**Conference Title :** ICST 2017 : International Conference on Sustainable Technologies

**Conference Location :** Amsterdam, Netherlands

**Conference Dates :** July 10-11, 2017