

A Sustainable Approach for Waste Management: Automotive Waste Transformation into High Value Titanium Nitride Ceramic

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Abstract : Automotive shredder residue (ASR) is an industrial waste, generated during the recycling process of End-of-life vehicles. The large increasing production volumes of ASR and its hazardous content have raised concerns worldwide, leading some countries to impose more restrictions on ASR waste disposal and encouraging researchers to find efficient solutions for ASR processing. Although a great deal of research work has been carried out, all proposed solutions, to our knowledge, remain commercially and technically unproven. While the volume of waste materials continues to increase, the production of materials from new sustainable sources has become of great importance. Advanced ceramic materials such as nitrides, carbides and borides are widely used in a variety of applications. Among these ceramics, a great deal of attention has been recently paid to Titanium nitride (TiN) owing to its unique characteristics. In our study, we propose a new sustainable approach for ASR management where TiN nanoparticles with ideal particle size ranging from 200 to 315 nm can be synthesized as a by-product. In this approach, TiN is thermally synthesized by nitriding pressed mixture of automotive shredder residue (ASR) incorporated with titanium oxide (TiO₂). Results indicated that TiO₂ influences and catalyses degradation reactions of ASR and helps to achieve fast and full decomposition. In addition, the process resulted in titanium nitride (TiN) ceramic with several unique structures (porous nanostructured, polycrystalline, micro-spherical and nano-sized structures) that were simply obtained by tuning the ratio of TiO₂ to ASR, and a product with appreciable TiN content of around 85% was achieved after only one hour nitridation at 1550 °C.

Keywords : automotive shredder residue, nano-ceramics, waste treatment, titanium nitride, thermal conversion

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