

## Research

### Rajasthan Clay Catalytic Converters for Automobiles

The current discovery, indicate new non-rare earth, non-noble metal based catalytic convertor using Rajasthan Clay. The catalytic convertor is developed by cleaver use Iron-Nickel-Cobalt nanoparticles in Rajasthan Clay. The metal oxides work as oxygen reservoir and could completely oxidize NO<sub>x</sub>, CO<sub>x</sub>, and hydrocarbons at lower than 300°C temperature.

### Background

Automobile industries are facing more and stricter emissions regulations in an effort to reduce the amount of harmful air pollutants that are released into the environment related to NO<sub>x</sub>, CO<sub>x</sub>, and soot along with particulate matter. Currently, one method of reducing harmful emissions is three-way catalytic (TWC) converter that reduces harmful NO<sub>x</sub> to N<sub>2</sub> and O<sub>2</sub>, oxidizes CO to CO<sub>2</sub>, and oxidizes residual hydrocarbons to CO<sub>2</sub> and water. However, it requires the use of the rare-earth element Cerium (Ce) and Palladium, which are increasing in price and suffering from supply problems lately. These expensive metals make the catalyst convertor one of the costliest part of car with price from \$1000-\$1500. Each catalytic convertor have about 5-7gm of pure palladium, which cost around \$60 per gram more expensive than gold. Despite that cost, the performance of catalytic convertors go down with time mostly in 8-10 years, while approved life of car is about 15 years.

The research team of Prof. Sharma has been working on find an alternate solution by understanding the catalytic convertor deactivation and looking for a cheaper solution for the same. His team has found that with time, palladium particle spread over Ceria undergo surface oxidation and decompose in small particle due to high temperature oxidation process (>320 degree). So there were three challenges, reduction of temperature, replacement of palladium and cerium with non-nobel metal, and re-design the convertor to prevent metal deactivation. The Fe-Ni-Co cooperative nano-particles were used in the isolated Nanospheres (work as single site catalyst) where Hafnia Rajasthan Clay used as oxygen reservoir. The catalytic performance was found to be better than conventional convertor at < 300 degree.

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Image credits: Rakesh K Sharma, SMCRG Lab

Link to published work (Patent): A hydrogen-annealed bimetallic oxide and implementations thereof  
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Research Domain: Environmental Science