

**Title** : Synthesis of High Entropy Alloy (MnFeCoNiCu) for dye degradation, thermoelectric and supercapacitor applications.

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**Area of research and Domain of research:**

High Entropy Alloy, Materials Science.

**Objective of the proposal:**

- To synthesize new high entropy alloys by simple co-precipitation process.
- The synthesized alloy will be tailored in the nanoscale and characterized using different techniques to understand its structural, optical and electrical properties.
- Finally, once the properties of the specific alloy are understood, they shall be utilized in the prescribed applications and evaluated for performance in comparison with the ongoing research activities in the relevant field.

**Background/short description:**

Fossil fuels play a major role in energy production but pose serious environmental problems. It is still a dream to develop a world powered by renewable energy sources. Semiconductor materials play important roles in energy harvesting and optoelectronics, with strong implications in many other activities with high societal impact, such as healthcare and environmental protection. Progress in many of these areas requires designing and tailoring functional properties of semiconductor materials on demand, but exploration of many of the traditional groups of semiconductors is exhausted to a large extent. High-entropy alloys (HEAs) represent a tremendous opportunity for material innovation since an overwhelming proportion of their compositional space is yet unexplored [1]. It is revealed that a handful of different HEAs displayed a broad range of functional properties [2]. The dumping of toxic industrial wastes in water resources poses a serious threat to human health and aquatic organisms. High-entropy alloys show remarkable potential in treating contaminants from industrial wastewater because of their improved catalytic properties [3]. HEA thermoelectric materials are useful for successfully converting waste heat, particularly at high temperatures

applications in the energy sector [4]. The project is targeted to impact global energy management and will contribute tremendously to materials technology and fundamental materials science.

### **Expected Results:**

The expected outcome of the project is aimed at securing energy resources. About 60% of the global primary energy consumption is lost during combustion and heat transfer processes [5]. Thus, energy recovery is a key instrument to restrain growing global energy demands and abate greenhouse gas emissions.

- MnFeCoNiCu HEA nanoparticles are synthesized using the simple co-precipitation method, showing remarkable photocatalytic degradation rates of Rhodamine B up to 93%.
- Development of HEA with enhanced electrical conductivity, mechanical properties, structural stability and low thermal conductivity for thermoelectric and supercapacitor applications.

### **References:**

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- [3] Lv, Z. Y., Liu, X. J., Jia, B., Wang, H., Wu, Y., & Lu, Z. P. (2016). Development of a novel high-entropy alloy with eminent efficiency of degrading azo dye solutions. *Scientific reports*, 6(1), 34213.
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- [5] Forman, C., Muritala, I. K., Pardemann, R., & Meyer, B. (2016). Estimating the global waste heat potential. *Renewable and Sustainable Energy Reviews*, 57, 1568-1579.