Development of multi-doped carbonaceous flame-synthesized composite nanomaterial for potential applications in energy storage devices and memristors.

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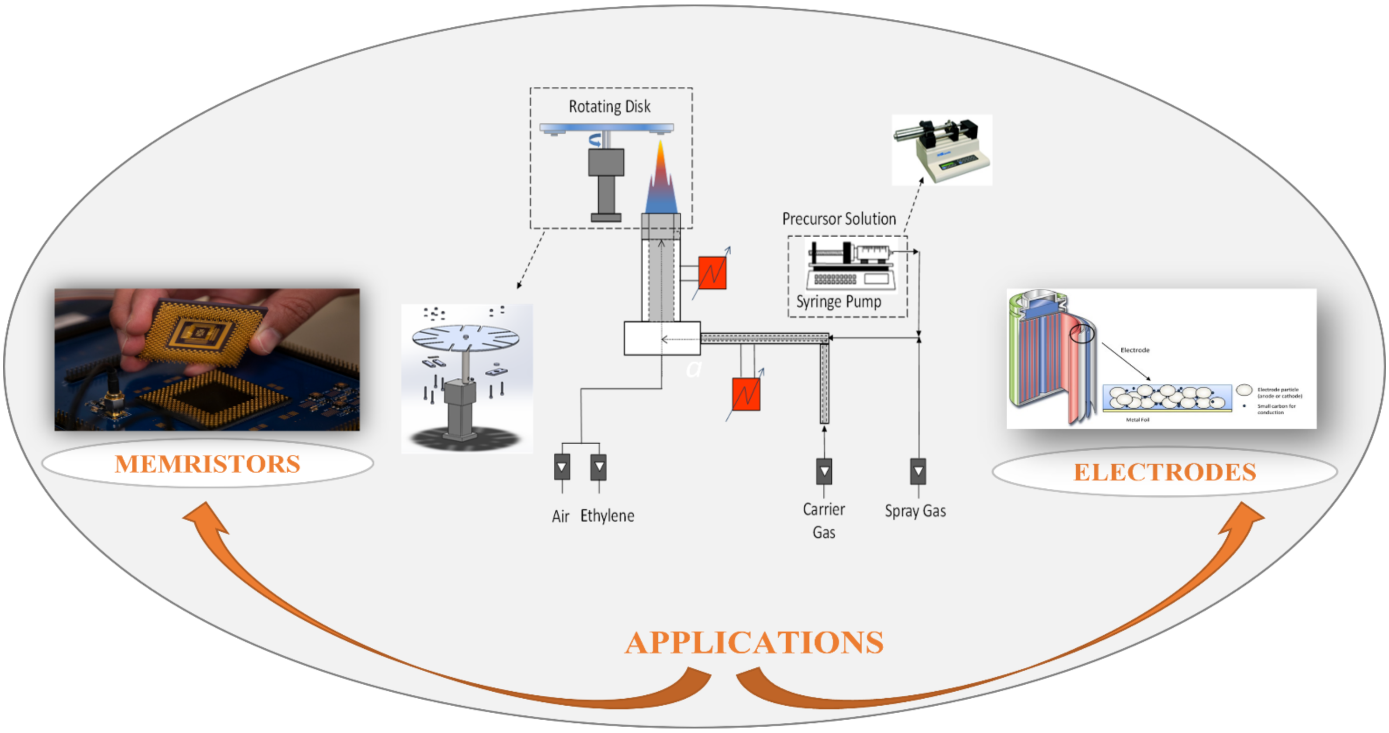
Modern research on advanced innovative technologies based on nanomaterials has received significant attention in the last two decades due to its distinguished potential in various applications. The role of nanomaterials has been evident from the recent advances in several areas including energy production, energy conversion, energy storage, biomedical sciences, environmental rehabilitation, electro-optics, electronic packaging, and many more. Basic phenomena of natural sciences and engineering coupled with different innovative approaches have reported various synthesis techniques for nanomaterials to be utilized for above mentioned applications. Furthermore, some chemical and physical modifications and experimental changes in those synthesis techniques are providing new hybrid nanomaterials with unique characteristics that can significantly enhance their performance with application perspective.

In recent years, flame-assisted synthesis has been extensively carried out for production of hybrid nanomaterials due to its scalability up to industrial level. In comparison to wet chemical synthesis techniques, flame synthesis possesses some excellent characteristics such as rapid reaction time, smooth production, and easy collection of produced powder or deposited thin films. Unlike wet chemical synthesis techniques, flame synthesis of nanomaterials for nanostructured coatings and thin film are produced with ease in one-step method, hence reducing production cost and avoiding toxic wastes. Producing efficient nanomaterials by generalized self-sustained, and environment friendly method is a major concern of scientific society. Here-in we propose a sustainable and efficient technique by single-step flame assisted synthesis for preparation of metal-oxide based hybrid carbonaceous nanomaterial. Single-step synthesis of several prominent micro-sized spherical semiconductor oxide such as Ta_2O_5, TiO_2, Nb_2O_5 and many others have been reported by this scalable flame synthesis technique.

Such metal-oxides based semiconductor materials can be employed in several applications including water splitting for hydrogen evolution reaction – HER (by their photocatalytic attributes), waste-water treatment, fuel sensitized photo-voltaic applications, electrode materials for electro-chemical energy storage devices and many more. I am focused on investigating the characteristics of titania based soot particles produced through flame synthesis method to be utilized for energy storage devices such as supercapacitors and negative electrode materials for lithium-ion batteries. Furthermore, I am also determined to investigate resistive switching phenomenon in titania and soot particles deposited through this technique along with their characteristics when further doped or synthesized through more than one precursor. With such behavior of soot-titania nanoparticles, it can be assumed that these materials can potentially be utilized for memristors by further modification.

I am extensively studying to further investigate such resistive switching behavior of soot-titania nanoparticles to be further optimized for such applications. Moreover, suitable metal ion doping of soot-titania nanoparticles (Metal/C/TiO_2) is also being investigated for improvement of quantum efficiency by preventing the recombination of photo/electro generated electron holes for otptimized energy storage devices.



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