

## Advancement of TRISO Nuclear Fuel Coaters for High Temperature Pebble Bed Nuclear Reactors: Environmentally Benign and Risk Free Proliferation 4<sup>th</sup> Generation Nuclear Energy

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The success on nuclear energy produced by advanced high temperature gas reactors (AGRs) is dependent on tri-isotropic (TRISO) fuel particle coating. Today modern AGRs require essentially zero defective/failed coated particles. Unfortunately, the scale-up and design of the current coating processes using gas-solid spouted beds have been based on empirical approaches and are operated as “black boxes” due to lack of fundamental understanding of the hydrodynamics of spouted bed coaters. Further complicating future fuel-coating technology and nuclear energy production is the fact that fuel kernels of different sizes and densities are required to be manufactured.

Therefore, in order to prevent the large risk associated with producing particles that do not meet the specifications, a fundamental understanding of the phenomena occurring in the spouted bed TRISO coater is needed. Accordingly, the overall research objectives of this project are 1) to advance the fundamental understanding of the hydrodynamics TRISO fuel coaters by systematically investigating the effect of design and operating variables, 2) to evaluate the reported dimensionless groups as scaling factors, 3) to establish a reliable scale-up methodology for TRISO fuel particle spouted bed coaters based on hydrodynamics similarity via advanced measurement and computational techniques, and 4) to develop an on-line, non-invasive measurement technique based on gamma ray densitometry (i.e., Nuclear Gauge Densitometry) that can be installed for industrial coater process monitoring to ensure proper performance and operation and to facilitate the developed scale-up methodology. To achieve these objectives the following research tools will be implemented and/or developed:

- Optical probes for solid and gas holdup and solids velocity distribution measurements.
- Gamma ray computed tomography (CT) for measuring the solid and gas holdup cross-sectional distribution along the spouted bed height, spouted diameter, and fountain height.
- Radioactive particle tracking (RPT) technique for measuring the 3D flow patterns and field, solids velocity, turbulent parameters, circulation time, and many others.
- Gas dynamics measurement technique.
- Pressure transducers.

In this presentation, the results and findings that are so far obtained with will be discussed and the work in progress will be outlined