

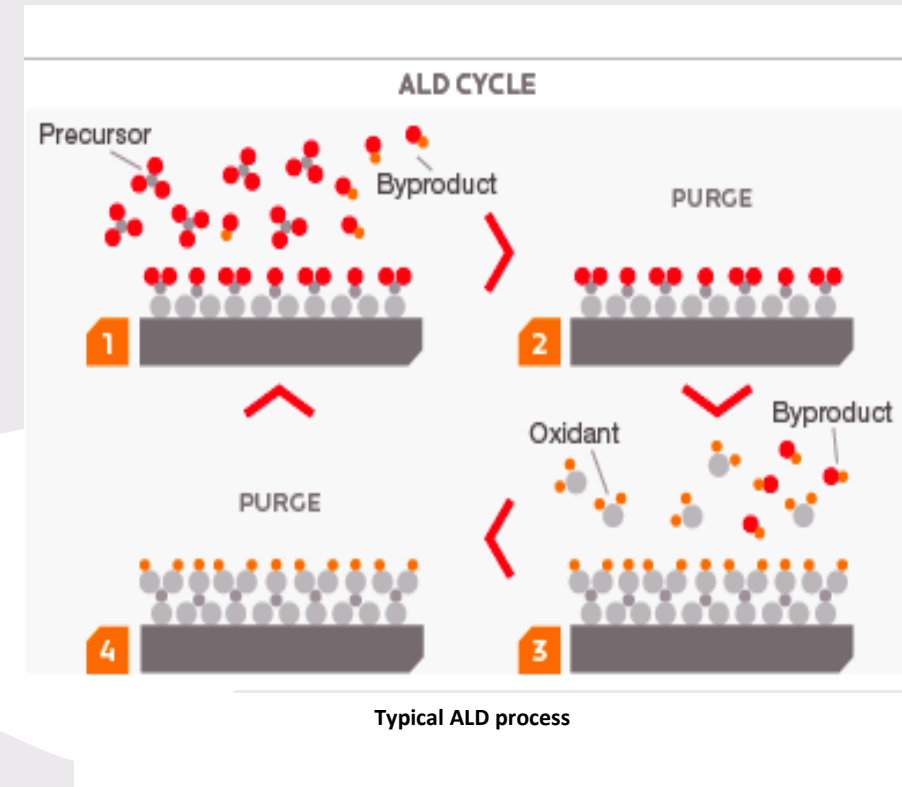
The background features a large, irregular white shape in the center. To the right, there are vertical streaks of color (red, orange, yellow, green, blue, purple) that appear to be part of a larger graphic. Several white circles of varying sizes are scattered across the white shape and the colorful area.

# Research Thrust-2: Nano-manufactured Systems for Space Applications

Sub-Project 1: Investigating ALD-coated components for space systems.

# Statement of R&D Problem

Since space as an environment and long-term survivability pose challenges to materials used in AM and these challenges need to be addressed. Atomic layer deposition (ALD) is a cost-effective nano additive-manufacturing technique that allows for the conformal coating of substrates with atomic control in a benign temperature and pressure environment (Fig.5). By using ALD, modification of these coatings can be accomplished during coating application preprocessing. The preprocessing is rendered directly on the coating dry pigment before binding. Through the introduction of paired precursor gases, thin films can be deposited on a myriad of substrates ranging from glass, polymers, aerogels, metals, powders, and other high aspect-ratio micro- and nanostructures.



# Statement of R&D Problem

By providing atomic-level control, where single layers of atoms can be deposited, the fabrication of metal transparent films, precise nano-laminates, and coatings of nano-channels and pores is achievable. ALD has the best layer thickness control and surface conformality among the thin film deposition methods. This conformality is also potentially beneficial for AM technology as it could ideally smoothen and fix the relatively porous and rough structure manufactured by the 3D printer. ALD has also a considerable variety of coating materials available. Due to the surface-controlled, cyclic character of ALD, the thickness of films can be accurately controlled, and highly conformal films can be deposited even on complex features.

