Summary of the Invention

Various embodiments~~The present invention~~ relates generally to a process for synthesizing a film or composition layer via non-contact pressure containment. The process ~~of the present invention~~ includes exposing a plurality of precursor layers to non-contact pressure, and then heating the plurality of precursor layers under the non-contact pressure to a reaction temperature sufficient to promote the formation of the thin film or composition layer. In one embodiment, the process ~~of the present invention~~ facilitates the synthesis of films or composition layers of desired crystalline structure, nanostructure and electronic properties using precursor layers deposited on a substrate, and non-contact pressure containment. In particular, the process ~~of the present invention~~ provides two or more precursor layers deposited in a stacked or laminate arrangement on a substrate. The process ~~of the present invention~~ promotes a chemical and/or physical interaction between adjacent precursor layers to produce the resulting film or composition layer.

The term "non-contact pressure" is intended to refer to any pressure exerted on the precursor layers without physical contact with a solid pressure imposing material. This contact pressure may be generated by any suitable means including, but not limited to, directly increasing the fluid pressure (e.g., gas pressure) in fluid communication with the plurality of precursor layers, or placing a vaporizable material in association with the plurality of precursor layers within a closed volume and vaporizing the vaporizable material to generate the non-contact pressure within the closed volume.

The precursor layers may be deposited on the substrate through vacuum deposition techniques, atmospheric-pressure deposition, and the like. Examples of vacuum deposition techniques include, but are not limited to, chemical vapor deposition (CVD), atomic layer deposition (ALD), chemical solution deposition (CSD), plating, physical vapor evaporation (PVD), and the like. Examples of PVD processes include, but are not limited to, thermal evaporation, electron-beam evaporation, ion beam deposition (IBD), molecular beam epitaxy (MBE), pulsed laser deposition, sputtering, and the like. Examples of atmospheric-pressure deposition include, but are not limited to, ultrasonic or pneumatic atomization spraying, inkjet spraying, direct writing, screen printing, slot die extrusion coating, and the like.

In one aspect ~~of the present invention~~, there is provided a process for synthesizing a thin film or composition layer from a plurality of precursor layers supported on a substrate, which comprises the steps of:

a) exposing the plurality of precursor layers to non-contact pressure; and

b) heating the plurality of precursor layers under the non-contact pressure to a reaction temperature sufficient to promote the formation of a reaction product in the form of the film or composition layer, wherein the exposing step further comprises: enclosing the plurality of precursor layers in a closed volume; and increasing the pressure within the closed volume to generate the non-contact pressure, wherein the enclosed volume is comprised of a sample carrier, a peripheral wall and a cover plate, said process further comprising placing the enclosed volume in a chamber and applying pressure to the enclosed volume within the chamber so that the cover plate is operatively sealed to the peripheral wall, wherein the pressure increasing step further comprises: adding a vaporizable material in association with the plurality of precursor layers within the closed volume; and vaporizing the vaporizable material within the closed volume to generate the non-contact pressure.