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# Synthetic Multifunctional Materials: Metallic-Intermetallic Laminate (MIL) Composites

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Abstract:
The field of material microstructure design targeted for a specific set of structural and functional properties is now a recognized field of focus in materials science and engineering. This talk describes a class of structural materials called metallic-intermetallic laminate (MIL) composites, which can have their micro-, meso-, and macro-structure designed to achieve a wide array of material properties and tailored to achieve specific functionalities. Structural materials with these performance-enhancing capabilities have been termed "synthetic multifunctional materials." Metallic-intermetallic laminate composites embody and exploit the concept of synthetic multifunctional materials. Structural composites, by their multiphase nature, offer many opportunities for the design of performance-enhancing multifunctional materials. Recently, a new class of structural materials has been developed at the University of California, San Diego, termed metallic-intermetallic laminate (MIL) composites. The goal of this materials development effort was to extrapolate upon the positive engineering properties exhibited by hierarchical multiphase complex natural composites, such as mollusk shells, to design and synthesize multifunctional composites to optimize specific structural properties, while facilitating low-cost, designable, and functional microstructures. The superior specific properties of this class of composites makes them extremely attractive for high-performance aerospace applications, and the fabrication method for creating MIL composites allows new embedded technologies to be incorporated into the materials, enhancing their functionality and utility. They have the potential to perform various other functions, such as thermal management, ballistic protection, blast mitigation, heat exchange, vibration damping, and sensing of various types through embedded devices. The materials are assembled layer by layer, with the functional features incorporated primarily within the intermetallic layers, and interconnections are completed within a given layer and between layers using electrically insulated wires. Strategies need to be developed that would allow the optimal integration of these interconnections while not significantly degrading material properties and performance.