

Design, discovery, growth and physical properties of novel intermetallic compounds

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The periodic table contains ~ 100 stable elements that can be combined to form innumerable compounds with un-thought-of properties. On the other hand, many elements, combinations of elements and / or crystal structures are predisposed toward manifesting specific properties and ground states. These two statements, taken together, mean that there is a wonderful opportunity to search for new or improved materials properties by the design, discovery, growth and characterization novel compounds. In these lectures I will first introduce the basic set of ideas / skills needed to search for and grow new compounds; in specific, single crystal growth from high temperature solution will be emphasized. Then I will review basic thermodynamic and transport properties associated with a variety of novel ground states and how to use these measurements to characterize new materials. Finally I will show how growth and characterization can be used as part of a research program that emphasizes design and discovery by reviewing specific examples of novel systems that we have studied over the past decades.