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High Temperature Superconductors: From Discovery to Applications

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Remember high-temperature superconductors? These high-tech darlings of the late 1980s brought a Nobel Prize to their discoverers and generated endless speculation about how their near perfect conduction of electricity would revolutionize the world we live in! Well, it hasn't happened - at least not yet. A key obstacle has been the difficulty of forming long, flexible wires which carry large amounts of supercurrents per unit area, from these brittle ceramic superconductors which essentially resemble "mud." It turns out that from a technical or performance standpoint, a long, flexible, single-crystal-like wire of the highly brittle, ceramic superconductor is required. From a cost-and-fabrication standpoint, an industrially scalable, low-cost process is required... with the goal being to meet or beat the price of copper wire! Both of these critical requirements are met by epitaxial deposition of superconductors on rolling-assisted-biaxially-textured-substrates (RABiTS). This technique employs simple, scalable, thermomechanical processing techniques to obtain a single-crystal-like, flexible, metal-based substrates in arbitrary lengths upon which epitaxial oxide buffer layers and superconductors are then deposited. Fundamental problems associated with the first generation superconducting wire technology leading to the present second generation wire technology will be discussed. Large-scale, bulk applications of high temperature superconductors are presently expected to be in billions of dollars by year 2020 and select applications will be discussed. This talk will take you on a journey from the discovery of high temperature superconductors towards realizing practical, large-scale, bulk applications of these novel materials.