

Materials Genome Initiative (MGI): A Disruptive Innovation in Discovery, Design, Development and Deployment (4Ds)

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The advancement of any technology is inherently dependent on the availability of suitable materials and compounds. A misalignment between the pace of novel material discovery, development, and production and the rapid progression of technological innovation poses a critical challenge to the development of emerging technologies. Traditional approaches to material discovery, predominantly based on experimental methods supplemented by computational techniques, have proven inadequate to address this gap. The Materials Genome Initiative (MGI), launched by the United States in 2011, represents a paradigm shift in the design, discovery, and deployment of novel materials. By integrating robust databases, advanced computational tools-such as Graph Networks for Materials Exploration (GNoME) pioneered by Google DeepMind-and autonomous laboratories, such as those at Lawrence Berkeley National Laboratory, MGI has dramatically accelerated the timeline for material discovery. What once required over two decades can now be achieved in less than a year, enabling unprecedented opportunities for groundbreaking and transformative technologies. Failure to engage in this field will inevitably lead to significant technological vulnerabilities, both in the near and distant future. To address this, a strategic roadmap for the Iranian Materials Genome Initiative is proposed as an immediate priority. Additionally, the establishment of an autonomous materials genome laboratory within a 5- to 7-year timeframe is essential. To oversee and coordinate such efforts, the creation of a National Materials Genome Center is imperative.

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