

Heuristics for the design of new materials

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New materials are largely developed serendipitously, requiring many thousands of individual experiments. This results in long development timelines, sometimes over decades, at excessive cost. Here, we ask what best practice in materials design looks like. The aim is to construct a theory of materials design and develop a materials design heuristic, which is a strategy that limits the search for solutions in large search spaces, such as multidimensional materials property space. A multiple case study approach is employed, using expert interviews to capture the stories behind effective materials development programs and thereby provide insight into tacit expert knowledge in order to construct systematic procedural knowledge. Participants are research scientists and engineers at universities, research organisations and companies with extensive materials design and development experience. Preliminary results suggest that the design of materials is more similar to the development of new technologies than the design of engineered artifacts and hence the design of materials is different to the design of many other engineered products and systems. For example, a materials design ends in a recipe not a drawing. As with other technologies, new materials are largely designed and developed through an evolutionary-like blind variation and selection process in which new materials evolve into the adjacent possible through many ideation-prototyping-evaluation cycles, enhanced by modelling, the integration of disparate knowledge sets and competitive co-creation.