A green chemistry-based decision modeling approach for optimal selection of nanomaterial’s synthesis method

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Abstract

Recent advances in nanotechnology have produced materials with superior performance in various industrial applications including medicine and advanced manufacturing. Synthesis of these so-called nanomaterials within the guiding philosophy of green chemistry has also continuously gaining attentions among researchers to address such emerging issue of sustainability. Green chemistry provides a set of principles which encourages the alternative design of product and processes that use renewable feedstock, and are energy efficient and safer with less hazardous pathway toward synthesis. However, optimal selection of such green synthesis method is a complex decision making problem that requires an integration of both tangible and intangible criteria. This work thus develops a metric from a green chemistry-inspired hierarchical decision model in prioritizing different synthesis methods of nanomaterial. A Monte Carlo simulation-aided Fuzzy Analytic Hierarchy Process (FAHP) coupled with Grey Relational Analysis (GRA) was used to rank the alternatives by integrating the knowledge from both peer-reviewed literature and experts in the field, while addressing the uncertainty involved in the decision making process. Such approach makes also the decision making transparent and open for new perspectives or criteria whenever relevant data becomes available. An illustrative example is presented for a case study of carbon nanotube synthesis.