Data-Driven Prediction and Design of Flame-Retardant Epoxy Materials and Textiles

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The characterization of flame retardant (FR) materials often requires measurements that are time-consuming, costly, and disruptive. Moreover, the amount of material available for flammability and fire performance screening is frequently limited. Machine learning (ML) techniques offer a powerful alternative for predicting fire-related parameters of polymeric materials and textiles, using input datasets of thermal and physico-chemical properties available in the literature for comparable systems. In this work, we demonstrate the application of ML algorithms to guide the design and development of FR hybrid epoxy nanocomposites and functional textiles [1, 2]. Fully connected feed-forward artificial neural networks can be employed to predict the heat release capacity of FR hybrid $Mg(OH)_2$–epoxy nanocomposites [1]. Additionally, electrospun fibers can be used to coat hemp blankets, creating a multilayer material with enhanced fire shielding properties. Despite the limitations of the initial datasets, generative ML approaches, through tailored decision trees and artificial neural networks, enable the prediction of ignition time and peak heat release rate for the multilayer system [2].

References

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