

Preface

Hollow particle-filled composites, called syntactic foams, are also classified as closed-cell foams. Enclosing porosity inside thin stiff shells of particles provides reinforcing effect to every void present in the materials microstructure. Such composites can be tailored to have higher specific modulus than the matrix resin and a high level of energy absorption under compression. Increasing interest of marine and aerospace structures in lightweight composites has generated considerable interest in finding new methods to enhance the properties of syntactic foams, including exploring micro and nanosized reinforcements. Higher gas mileage requirements for automobiles have also pushed them to look for lighter weight materials, where syntactic foams are expected to be useful in some components.

In reinforced syntactic foams, the presence of hollow particles and one or more additional reinforcing phases can generate complex deformation and failure mechanisms. The interaction between the mechanisms contributed by micro- and nano-scale materials can also be complex. Only systematic large-scale experimental studies followed by modeling and simulation efforts can help in decoupling such effects and help in designing effective material microstructures. Often, the incorporation of additional phase may be directed by the desire of obtaining a specific set of properties, which may not be limited to mechanical properties. Carbon nanotube and nanofibers affect mechanical, electrical, and thermal properties of syntactic foams. Such reinforced syntactic foams may be developed in the form of multifunctional materials.

This work summarizes and critically analyzes the progress made in the design and analysis of reinforced syntactic foams. Nanofibers, nanoclay, and microfibrers provide different strengthening mechanisms in reinforced syntactic foams. Comparative studies conducted in this book have shown some surprising trends. For example, irrespective of the reinforcement type, the tensile and compressive properties of most reinforced syntactic foams vary linearly with respect to the composite density. It is also shown that the existing theoretical models can be extended to predict the elastic properties of nanoscale reinforced syntactic foams and the results are validated with the experimental data. Discovery of commonality in the experimental trends and applicability of theoretical models can guide future studies and help in understanding the potential for developing syntactic foams for transportation and structural applications.

From a vast body of literature on reinforced syntactic foams, it is possible to miss some contributions in the references. We have primarily covered the information available in journal publications. The field continues to evolve at a rapid pace. Advancements in the understanding of nanomaterials and nanocomposites directly impact the reinforced syntactic foams field. We hope that this brief book will provide a starting point for the interested readers to gain basic understanding about the major material parameters and mechanical properties of reinforced syntactic foams.

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