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Carbon nanotubes reinforced metal matrix nanocomposites

Nanocomposites are multiphase or hybrid materials, which when combined, display markedly different properties from the conventional materials. Metallic matrices reinforced by nanoparticles are very promising materials. In the last years, carbon nanotubes (CNTs) have generated a great attention from the research community due to the extraordinary properties combined with its low weight. The use of CNTs as reinforcement material for metal matrix composites has been studied owing to the potential hardening effect of these hard and stiff nanomaterials. Metal matrix nanocomposites are excellent candidates for various applications due to high strength and stiffness, desirable coefficient of thermal expansion and good damping properties. Structural weight reduction to minimize the cost is one of the desired outcomes in the automobile, aerospace and aircraft industries. One way to achieve this goal is the replacement of the conventional metallic structures by advanced nanocomposites. The greatest challenges facing the development of nanocomposites for wide application are the cost of nanoscale reinforcements and the cost and complexity of synthesis and processing of these nanocomposites. As with conventional composites with micron-scale reinforcements, the properties of the nanocomposites are strongly dependent on the properties of reinforcement material, distribution, and volume fraction, as well as the interfacial bond between the reinforcement and the matrix. The strengthening obtained with the introduction of carbon-based nanomaterials such as carbon nanotubes and graphene has been proven through several published works. However, the interest in research on this subject continues since it is crucial the development of new approaches to production and dispersion techniques to make feasible the implementation of these nanocomposites. The main challenges in this field are the development of synthetic techniques that are economically producible; provide a homogeneous dispersion of reinforcement through the matrix and; lead to a strong interfacial bond between the matrix and the reinforcement.

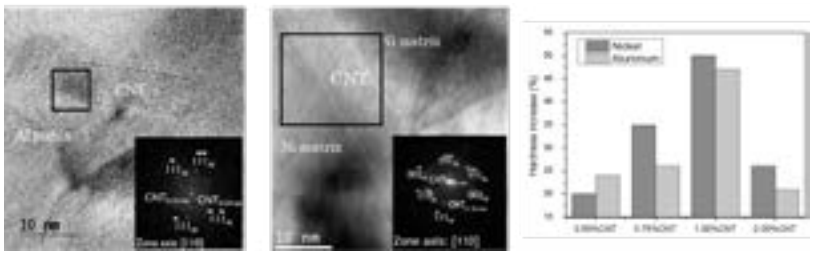

Figure 1: HRTEM images of metal matrix nanocomposites and the hardness evolution with CNTs amount

Recent Publications

1. Araujo PT, Barbosa Neto NM, Sousa MES, Angélica RS, Simões S, Vieira MFG, Dresselhaus MS, Leite dos Reis MAL (2017) Multiwall carbon nanotubes filled with Al4C3: Spectroscopic signatures for electron-phonon coupling due to doping process. Carbon 124:348-356.
2. Simões S, Viana F, Reis MAL, Vieira MF (2017) Aluminum and nickel matrix composites reinforced by CNTs: Dispersion/mixture by ultrasonication. Metals 7:279.

3. Dos Santos Rodrigues FA, Paraguassu W, Simões S, Vieira MFG, Da Silva Souza JA, De Magalhães Braga E, Dos Reis MAL (2017) Electrical and tensile properties of carbon nanotubes-reinforced aluminum alloys 6101 wire. Journal of Nanoscience and Nanotechnology 17:4837-4841.
4. Simões S, Viana F, Reis MAL, Vieira MF (2016) Microstructural characterization of aluminum-carbon nanotube nanocomposites produced using different dispersion methods. Microscopy and Microanalysis 22:725-732.
5. Simões S, Viana F and Vieira MF (2016) Carbon Nanotubes and their Nanocomposites In: Visakh P M, Abdolreza H Nanomaterials and Nanocomposites-Zero- to Three-Dimensional Materials and Their Composites 2016 Wiley-VCH Verlag GmbH, Germany- ISBN: 978-3-527-33780-4.

Biography

Sónia Simões is an Assistant Professor at the Department of Metallurgical and Materials Engineering of University of Porto. During the last years of her research, she mainly addressed the study of microstructural and mechanical characterization of nanomaterials, thin films, multilayers, joining interfaces, carbon nanotubes and nanocomposites that resulting on 45 papers in international scientific journals listed in ISI- Web of Science, one book chapter and one book. She is interested in understanding the relationships between the microstructure and the properties of materials and the fundamental underlying mechanisms of structural and property changes induced by some microstructure features (grain growth, formation of new phase). Since 2006, she accumulated valuable experience in transmission electron microscopy, which has been an extremely important tool in the development of the research work.

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