Consiglio Nazionale delle Ricerche

Istituto di Chimica e della Materia Condensata e di Tecnologie per l'Energia

ICMATE

High-Entropy Alloys on graphite: wetting and reactivity evaluation by CALPHAD method

High-Entropy Alloys (HEAs), studied during last years with the aim to replace Ni- and Co-based super-alloys, have been more recently considered for sectors involving liquid-phase processing routes, such as brazing, casting, infiltration to produce composites, production of coatings, etc. Among the broad family of HEAs, AlCoCrFeNi shows appealing mechanical properties, and excellent corrosion and oxidation-resistance; the addition of refractory metals, such as Mo and Ta, was found to enhance the formation of secondary phases improving hardness, compressive and yield strength. In this study, wettability and interfacial reactivity of three HEAs in contact to graphite were investigated for the first time. An in house-built thermodynamic database, including all HEAs elements and carbon was used, together with CALPHAD method, to simulate and discuss liquid-solid interfacial phenomena occurring at high temperatures. This combined experimental-theoretical approach allows to increase the reliability of the database representing, as the same time, a fundamental tool to define the most promising conditions for reaching the desired materials performances.

Sofia Gambaro, researcher at CNR ICMATE, unit of Genova, graduated in Chemistry, Ph.D. in Materials Science, 2 years post-doc at the Laboratoire de Biomatériaux et de Bioingénierie, Laval University (Quebec, Canada). Her research activity involves:
1) Experimental and theoretical studies of wettability of ceramics by liquid metals, metal-ceramic interactions and joining technologies; 2) Design and characterization of biodegradable alloys, and their related surface modification, used to produce temporary biomedical implants.

Integration of antibacterial properties in biomedical alloys by additive manufacturing

Bacterial infection is currently among the first three most common reasons for failure of biomedical implants, significantly contributing to the need for revision surgeries. In this light the introduction of antibacterial elements in currently used biomedical metallic alloys could help in limiting the development of bacteria after surgery, thus improving patients' health and providing considerable savings for the national health system. Additive manufacturing technologies can be instrumental in allowing this alloying process, as the their powder-based nature and the rapid solidification associated to the process may help in obtaining the desired results, even with volatile elements. Such approach was explored with different biomedical alloys (conventional Ti6Al4V as well as pseudo-elastic NiTi) and antibacterial elements (Cu and Zn). Laser powder bed fusion allowed to produce advanced implants, which integrate the antibacterial functionality in personalized medical implant.

Jacopo Fiocchi, researcher at CNR ICMATE, unit of Lecco. Graduated in Materials Engineering, Ph.D. in Mechanical Engineering. His research interests focus on the development of novel metallic alloys and the effect of advanced processing methods on their properties.

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Seminar "Science for Sustainable Development"

Dr. Sofia Gambaro, ICMATE-CNR Genova

Dr. Jacopo Fiocchi, ICMATE-CNR Lecco

12 June 2024 3.00 pm

Registration LINK