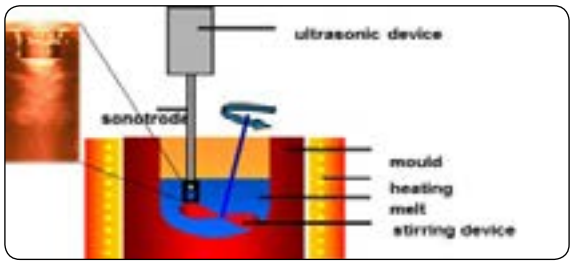
Hajo Dieringa et al., J Material Sci Eng 2018, Volume 7
DOI: 10.4172/2169-0022-C8-113

Magnesium based Nanocomposites – Challenges and Potential

Hajo Dieringa and **Karl Ulrich Kainer**
Helmholtz-Zentrum Geesthacht, Germany

Magnesium-based metal matrix nanocomposites (MMNCs) are promising materials for small-series applications, for example in automotive engineering or the aviation industry. For some years now, ceramic nanoparticles have been so inexpensive that they only represent a negligible increase in the cost of a nanocomposite material. The magnesium sand casting alloy Elektron21 and the die-casting alloy AM60 were reinforced with AlN nanoparticles with a diameter of 80 nm. To break up particle clusters in the melt, an ultrasound assisted casting process was used. Cavitation and acoustic streaming are generated by ultrasound, and an indirect chill casting process in a permanent mould results in a microstructure free of pores. The grain size, tensile mechanical properties and compression creep resistance were investigated. We found that the nano-AlN addition refines the microstructure of AM60 significantly. Mechanical testing shows an outstanding increase in tensile yield strength, ultimate tensile strength and ductility of AM60+1AlN compared to the unreinforced AM60. By contrast we observed no grain refinement and no tensile strengthening of Elektron21, although the creep resistance was improved by one order of magnitude. This demonstrates how differently two magnesium alloys can respond to reinforcement with 1% AlN in their structures and properties. In case of AM60-MMNCs remelting trials were performed and showed that the nanoparticles remain in the melt with only a marginal loss of grain refinement and loss of strength occurring for each remelting.



Recent Publications:

1. Saboori A, Padovano E, Pavese M, Dieringa H, Badini C (2017) Effect of Solution Treatment on Precipitation Behaviors, Age Hardening Response and Creep Properties of Elektron21 Alloy Reinforced by AlN Nanoparticles; Materials 10:1380-1397.
2. Dieringa H, Katsarou L, Buzolin R, Szakács G, Horstmann M, Wolff M, Mendis Ch, Vorozhtsov S, StJohn D (2017) Ultrasound Assisted Casting of an AM60 Based Metal Matrix Nanocomposite, Its Properties, and Recyclability; Metals 7:388-400.
3. Daudin R, Terzi S, Mallmann C, Sanchez Martin R, Lhuissier P, Boller E, Pacureanu A, Katsarou L, Dieringa H, Salvo L (2017) Indirect improvement of high temperature mechanical properties of a Mg based alloy Elektron21 by addition of AlN nanoparticles; Materials Science & Engineering 688:76-82.
4. Katsarou L, Mounib M, Lefebvre W, Vorozhtsov S, Pavese M, Badini C, Molina-Aldareguia J M, Cepeda Jimenez C, Pérez Prado M T, Dieringa H (2016) Microstructure, mechanical properties and creep of magnesium alloy Elektron21 reinforced with AlN nanoparticles by ultrasound-assisted stirring; Materials Science & Engineering A 659:84-92.
5. Dieringa H, Das S, Eskin D, Fan Z, Katsarou L, Horstmann M, Kurz G, Mendis C, Hort N, Kainer KU (2015) Twin-roll Casting after Intensive Melt Shearing and Subsequent Rolling of an AM30 Magnesium Alloy with Addition of CaO and SiC; Materials Science Forum 828-829:35-40.
6. Sillekens W, Jarvis DJ, Vorozhtsov A, Bojarevics V, Badini CF, Pavese M, Terzi S, Salvo L, Katsarou L, Dieringa H (2014) The ExoMet Project: EU/ESA Research on High-Performance Light-Metal Alloys and Nanocomposites; Metallurgical and Materials Transactions A 45:3349-3361.

7. Dieringa H (2011) Properties of magnesium alloys reinforced with nanoparticles and carbon nanotubes: a review; Journal of Materials Science 46:289-306.

Biography

Hajo Dieringa has his expertise in developing magnesium alloys and magnesium based metal matrix composites. Since 2000 he is working at the Institute of Materials Science at GKSS Research Centre, now Helmholtz-Zentrum Geesthacht. He is deputy head of the department "Magnesium Processing" and coordinated the work package "Metal Matrix Nanoconposites" in the large scale EU project Exomet. In addition to composites, Hajo Dieringa also developed creep-resistant magnesium alloys.

hajo.dieringa@hzg.de

Notes: