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Deformation of magnesium alloys for lightweight structural applications

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Abstract

Vehicle lightweighting is today recognized as one of the predominant approaches to improve fuel efficiency and reduce anthropogenic climate-changing, environment-damaging, costly and human death-causing emissions, since every 10% reduction in weight would lead to about 6~8% increase in fuel efficiency. This, along with materials designed for improved fatigue, creep, impact or corrosion resistance, has been identified as one of six areas critical to solving national and global grand challenges. Magnesium alloy, as an ultra-lightweight metallic structural material, has been increasingly used in the transportation industry to reduce the weight of vehicles. However, the hexagonal close-packed crystal structure of magnesium alloys limits the availability of slip systems and results in strong mechanical anisotropy and tension-compression yield asymmetry due to the presence of twinning and the related development of deformation texture. For the vehicle components subjected to dynamic cyclic loading, such asymmetry could exert an unfavorable influence on the material performance and compromise the structural integrity, safety, and durability of highly loaded structural components. This problem could be overcome through weakening the basal texture via the addition of rare-earth (RE) elements. In this talk a few examples on the deformation behavior of extruded magnesium alloys containing both high and low RE contents will be presented in comparison with RE-free extruded magnesium alloys. Furthermore, twinning and twin growth during uniaxial compression along the extrusion direction and de-twinning along the transverse direction will be discussed as well.

Biography:

Daolun Chen is a Professor of Ryerson University, Toronto, Canada. He completed his BSc and MSc at Northeastern University (China), PhD at Chinese Academy of Sciences, and Dr.rer.nat. at University of Vienna. Dr. Chen has published 398 peer-reviewed journal (316) and conference (82) papers, plus 190+ non-refereed conference papers/research reports. He is a recipient of numerous prestigious awards, including Premier's Research Excellence Award, Canadian Metal Physics Award, G.H. Duggan Medal, MetSoc Award for Research Excellence, MetSoc Distinguished Materials Scientist Award. Dr. Chen is an elected Fellow of Canadian Academy of Engineering (FCAE), and an Editorial Board Member of 28 journals.

Speaker Publications:

1. Qu, S.J., Tang, S.Q., Feng, A.H., Feng, C., Shen, J., and Chen, D.L. "Microstructural Evolution and High-Temperature Oxidation Mechanisms of a Titanium Aluminide Based Alloy." Acta Materialia, vol. 148, 2018, pp. 300-310.
2. Yan, C.K., Feng, A.H., Qu, S.J., Cao, G.J., Sun, J.L., Shen, J., and Chen, D.L. "Dynamic Recrystallization of Titanium: Effect of Pre-activated Twinning at Cryogenic Temperature." Acta Materialia, vol. 154, 2018, pp. 311-324.
3. Mokdad, F., Chen, D.L., and Li, D.Y. "Single and Double Twin Nucleation, Growth, and Interaction in an Extruded Magnesium Alloy." Materials and Design, vol. 119, 2017, pp. 376-396.
4. Mokdad, F., Chen, D.L., Liu, Z.Y., Xiao, B.L., Ni, D.R., and Ma, Z.Y. "Deformation and Strengthening Mechanisms of a Carbon Nanotube Reinforced Aluminum Composite." Carbon, vol. 104, 2016, pp. 64-77.
5. Macwan, A., Chen, D.L., Marr, M., and Kesler, O. "Residual Stresses in Suspension Plasma Sprayed Electrolytes in Metal-Supported Solid Oxide Fuel Cell Half Cells." Journal of Power Sources, vol. 221, 2013, pp. 397-405.

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