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Forming of Aluminum Alloys for Lightweight Automotive Applications

Aluminum is the most abundant metal in the earth's crust and it has an approximately three times lower density than steel. Yet, the majority of today's mass-market automobiles are still made of steel and the use of aluminum in a typical car accounts for a very small fraction of its total weight. Further, with the recent buzz around the use of aluminum in commercial cars (e.g., Tesla) and pick-up trucks (e.g., Ford), one wonders why aluminum is used so little in commercial automobiles. While the relatively greater cost of aluminum (compared to steel) is one of the contributing factors, there are some fundamental scientific reasons relating to the FCC crystal structure and deformation behavior of Al that have limited its use, specifically in sheet form, for mass-market automotive industry. In this talk, current research to enable greater use of Al sheet in automotive applications will be presented. The focus of the talk will be on unique experiments developed at the Pacific Northwest National Laboratory where the forming ability of Al sheet is demonstrated to increase under high strain-rate deformation. Results of this research will be presented along with a discussion of how fundamental materials' behavior, in combination with commercial forces, influence materials usage in practical applications.

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Aashish Rohatgi has been with PNNL-Richland since 2008 in the Energy Materials - Transportation and Industrial Materials Group. He has led several projects on light-weight materials development for the automotive industry such as on warm-forming of magnesium, high-rate forming of aluminum and steel, polymeric foams with metal-foam like performance, etc. He is an expert in the fundamental aspects of deformation behavior of materials, focusing on microstructure-property correlations during high strain-rate deformation. He is experienced in the use of Hopkinson bars, load frames, SEM, TEM, EBSD, DSC etc. analytical techniques. He was previously with the Naval Research Laboratory, DC, where he led research on the development of multi-functional composites for the navy. He has co-authored over 30 publications and serves on the editorial board of Metallurgical Transactions A as a Key Reader.

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