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Forced chemical mixing and self-organization in alloys subjected to severe plastic deformation

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Abstract Materials are commonly subjected to plastic deformation, in particular during their fabrication and shaping, and in service. This plastic deformation can alter phase stability in alloys, and thus modify their properties. In addition to these effects, our research at Illinois has shown that alloys subjected to severe plastic deformation display a general tendency to self-organize at the nanoscale. This self-organization, which can be observed at temperatures where thermal diffusion is or is not significant, results from competing kinetic processes with distinct characteristic length scales. Using experiments on model immiscible alloy systems, modeling, and atomistic simulations, we show that different processes need to be considered depending upon the degree of immiscibility of the elements in presence. These results will be illustrated in binary and ternary Cu-base alloys processed by ball milling, accumulative roll bonding, and high-pressure torsion, or subjected to sliding wear. We will show that a particular self-organization reaction leading to the formation of nanolayers can be used to design materials with improved sliding wear resistance.

Bio sketch Pascal Bellon earned his PhD in Materials Science from University of Paris 6, France. He worked for 7 years at CEA-Saclay, France, before joining the Department of Materials Science and Engineering at the University of Illinois at Urbana-Champaign as a tenure-track Assistant Professor in 1996, where he was promoted to the rank of Associate Professor in 2002 and Full Professor in 2009. Dr. Bellon received an NSF career award in 1998 and awards from the Academy for Excellence in Engineering Education from the University of Illinois in 1998, 1999 and 2000. He received the Don Burnett teaching award in 2000, the Accenture Engineering council award for Excellence in Advising in 2007 and the Stanley Pierce award in 2009. Named a Racheff faculty scholar in 2012, Dr. Bellon was inducted as the Donald W. Hamer Professor in Materials Science and Engineering in 2016.

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