Carnegie Mellon
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Pranay Choudhary
Graduate Research Assistant
Department of Materials Science and Engineering
Carnegie Mellon University

"Effects of Fine scale microstructure and Inclusions on the toughness of Low Alloy Medium Carbon Steels"

Friday, February 20, 2009
11:00 A.M. Seminar in Baker Hall 136A
Refreshments precede seminar at 10:30 A.M. in 2325 Wean Hall

In previous work it has been shown that one can improve, at constant inclusion volume fraction, the fracture toughness of ultra high strength steels by increasing the inclusion spacing or by making the inclusion particles more resistant to void nucleation. One can increase the inclusion spacing by adding rare earth elements to form large and widely spaced inclusions. One can make the sulfide particles more resistant to void nucleation by adding small amounts of titanium to form small, closely spaced particles of titanium carbosulfide (Ti_2CS). The fine particles of Ti_2CS particles are much more resistant to void nucleation than other sulfide types and this increased resistance to void nucleation can result in significant improvements in toughness. Further, one can also increase toughness by having a fine scale microstructure inherently resistant to fracture.

In this work we considered two sets of low alloy steels. There were three heats in each set and the alloys within each set differed in the way the sulfur was gettered. In one heat the sulfur has been gettered as particles of CrS. In a second an addition of lanthanum has been made to getter the sulfur as particles of La_2O_2S. In the third heat an addition of titanium was made and the sulfur was gettered as particles of Ti_2CS. It was found that both rare earth and Ti additions significantly improved the toughness.

The two sets of steel differed in that in one set there was no silicon in the steels but in the other set there was an addition of two wt. % silicon. The heats with the silicon addition were made to investigate the effects of silicon on the formation and the void nucleation resistance of inclusions in the rare earth treated steels and of the inclusions in the titanium modified steels.

Pranay received his Bachelor degree in Metallurgical Engineering from Punjab Engineering College, Chandigarh in 2004 and a Masters Degree in Materials Science & Engineering from Carnegie Mellon University in 2006. He is currently a Ph.D. candidate under the guidance of Prof. Warren Garrison.