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# Aluminum-Enhanced Deep Drawability: Insights into Texture and Recrystallization Kinetics in Interstitial Free Steels

Rameez R Tamboli<sup>1</sup> and Suhash Ranjan Dey\*<sup>1</sup>

<sup>1</sup>Indian Institute of Technology [Hyderabad] – India

## Abstract

This study investigates the impact of aluminum content on the deep drawability of interstitial free steels crucial for automotive applications. Using electron backscatter diffraction, it reveals a stronger ND  $\langle 111 \rangle$  fiber texture in high-aluminum (High-Al) steels compared to low-aluminum (Low-Al) counterparts after full recrystallization. High-Al steels exhibit a higher Lankford parameter ( $r_m$ ) value, indicating improved formability. They also demonstrate faster recrystallization kinetics, attributed to rapid ND fiber grain nucleation. In contrast, Low-Al steels experience temporary strengthening during early recrystallization, hindering ND fiber grain nucleation. Precipitation studies show the absence of aluminum-containing precipitates in High-Al steels, while high-resolution secondary ion mass spectrometry imaging confirms elevated aluminum presence on specific grain boundaries. Molecular statics simulations reveal a decrease in grain boundary energy with aluminum addition, resulting in a system reaching a minimum energy state. Overall, this study underscores the pivotal role of aluminum in enhancing deep drawability through texture development, recrystallization kinetics, and grain boundary energy reduction in interstitial free steels.

**Keywords:** Deep drawing, texture, recrystallization

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\*Speaker