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# Opportunities for Sustainable Metallurgy with High-Energy XFEL Microscopy

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Metallurgy has enabled technological innovation for millennia, but scientific uncertainties still limit progress in shifting the processes to sustainable alternatives at scale. Of the ~30% of global emissions that originate from our supply chain, >10% of those emissions originate from complex metallurgical processes understood predominantly at the process scale. From ore extraction to forging or 3D printing technologies, we require fundamental models to connect scientific advances to new and scalable engineering strategies. Across these fields, however, unanswered questions persist due to missing experimental techniques to resolve them deep inside opaque and high-Z materials. In this talk, I will introduce challenges in sustainable metallurgical engineering and discuss avenues in which advanced microscopy with high-energy X-rays can enable transformative changes in our understanding and control of these new systems.

**Primary author:** Prof. DRESSELHAUS-MARAIS, Leora (Stanford University)

**Presenter:** Prof. DRESSELHAUS-MARAIS, Leora (Stanford University)

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