



**Exponent<sup>®</sup>**  
Engineering & Scientific Consulting

## Trevor Ballard, Ph.D.

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### Professional Profile

Trevor Ballard is a metallurgical engineer specializing in microstructure-property relationships in ferrous alloys. Trevor has experience applying laboratory based thermomechanical simulation techniques, such as hot compression and hot torsion testing, to predict critical temperatures during industrial rolling schedules.

Various metallographic and characterization techniques including optical microscopy, energy dispersive x-ray spectroscopy (EDS), and transmission electron microscopy (TEM) have played important roles in his work to show the relationship between material properties and the corresponding microstructure at the micron and nano scales.

During his PhD work, Trevor developed a double-twist torsion method to study changes in recrystallization behavior at various temperatures in microalloyed plate steels. Chemical etching and light optical microscopy were used to develop the relationship between trends observed in the mechanical data and trends observed in the microstructure. TEM analysis was used to study the evolution of precipitate size and composition throughout the double-twist torsion test relative to changes in mechanical behavior and austenite recrystallization.

### Academic Credentials & Professional Honors

Ph.D., Metallurgical and Materials Engineering, Colorado School of Mines, 2022

B.S., Metallurgical and Materials Engineering, Colorado School of Mines, 2017

Recipient, Jerry Silver Award, Association for Iron and Steel Technology, 2021

### Prior Experience

Undergraduate Research Assistant, Colorado School of Mines, 2015-2017

Graduate Teaching Assistant, Colorado School of Mines, 2017-2021

### Publications

T. J. Ballard, J. G. Speer, K. O. Findley, and E. De Moor, "Evolution of Austenite Microstructure and Microalloy Precipitation State During Double-Twist Torsion Testing on Nb-Ti-Bearing Steels," *Materialia*, vol. 31, 2023.

C. Finfrock, D. Bhattacharya, B. McBride, T. Ballard, and A. Clarke, "Decoupling the Impacts of Strain

Rate and Temperature on TRIP in Q&P Steel," *JOM*, 2022.

T. Ballard, J. Speer, K. Findley, and E. De Moor, "Double-Twist Torsion Testing to Assess Partial Recrystallization in Microalloyed Steels," *AIST Transactions*, vol. 18, no. 3, pp.240-246, 2021.

C. Finfrock, M. Thrun, D. Bhattacharya, T. Ballard, A. Clarke, and K. Clarke, "Strain Rate Dependent Ductility and Strain Hardening in Q&P Steels," *Metallurgical and Materials Transactions A*, vol. 5, pp. 928-942, 2021.

T. Ballard, J. Speer, K. Findley, and E. De Moor, "Double-Twist Torsion Testing to Determine the Non Recrystallization Temperature," *Scientific Reports*, vol. 11, no. 1495, 2021.

R.Cryderman and T. Ballard, "Short Time Austenitizing Effects on the Hardenability of 0.55 wt pct Carbon Steels," *Metallurgical Research and Technology*, vol. 115, no. 403, 2018.

### **Presentations**

T. Ballard and E. De Moor, "Effect of Alloying Content on Fractional Softening Behavior and Microstructural Evolution During Double-Twist Torsion Testing of Microalloyed Steels," MS&T21, Columbus, OH, 2021.

T. Ballard, J. Speer, K. Findley, and E. De Moor, "Double-Twist Torsion Testing to Assess Partial Recrystallization in Microalloyed Steels," MS&T20, virtual, 2020.

T. Ballard and E. De Moor, "Double-Twist Torsion Testing to Determine the Non-Recrystallization Temperature," 7th International Conference on Recrystallization and Grain Growth, Ghent, Belgium, 2019.