

Measurement of the DBTT in 3.4% silicon steel by tensile tests at high strain rate using a servo-hydraulic machine

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The ductile-to-brittle transition temperature (DBTT) of 3.4% silicon steel was determined at strain rates of 0.001 s^{-1} , 0.01 s^{-1} , 1 s^{-1} , 10 s^{-1} and 100 s^{-1} . To determine the DBTT of 3.4% silicon steel, the tensile tests were conducted at various strain rates and the fracture elongation was measured. The tests were conducted using Instron 4206 for quasi-static tensile tests and a servo-hydraulic machine for dynamic tensile tests. The DBTT was evaluated at a temperature ranged from $-50 \text{ }^{\circ}\text{C}$ to $100 \text{ }^{\circ}\text{C}$ and a chamber was used for all tests, except tensile tests at room temperature. Dog-bone-shaped specimens with a thickness of 1.6t and a gauge section of 30 mm were designed for tensile tests and thermocouple was used for measurement of temperature at specimen surface during the tests. For accurate measurement of the fracture elongation, Digital Image Correlation (DIC) method was employed and captured incrementally deformed specimen images by a high-speed camera. The DBTT from test results was represented in terms of fracture strain with the temperature at various strain rates. The test results show that the DBTT of 3.4% silicon steel has strain rate effect as the strain rate increases, the transition temperature increases. Figure 1 shows the DBTT of 3.4% silicon steel at various strain rates. The square symbols denote test data and solid lines of each color are the smoothed data.

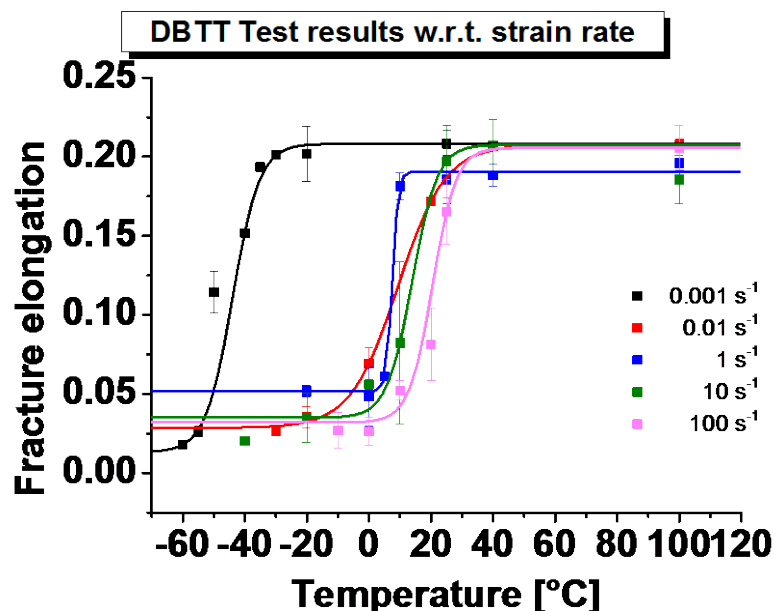


Fig. 1 The DBTT test results w.r.t. various strain rates

Keywords(optional): DBTT, Silicon steel, Strain rate, Dynamic tensile tests, Digital Image Correlation (DIC)