The Ex-situ fatigue response of nickel superalloys in response to supercritical CO2 exposure.

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Abstract:
Fatigue is known to cause unexpected failures which can be financially expensive. All parts of turbines undergo fatigue from thermal cycling of the casing, to immense creep-fatigue of rotors to mechanical fatigue of airfoils. In addition to quantifying materials response in low cycle fatigue and high cycle fatigue, fatigue crack growth rates are important to quantify as they enable engineers to calculate minimum life of structural components. Fatigue is particularly important to evaluate in CO2 environments as efficient energy production demands a shift from classic turbine working fluids of high pressure steam to CO2. As a preliminary investigation of the fatigue crack growth rate properties for nickel superalloys, compact tension specimens Haynes 282 and Inconel 625 were exposed to supercritical CO2 at 730C under 200 Bar for 500 hours. Further samples were also exposed to CO2 at 730C and 1 Bar for 500 hours and supercritical steam at 730C under 200 Bar for 500 hours. The subsequent room temperature crack growth threshold was measured and reported. This presentation will discuss the effect prior exposure had on fatigue thresholds. Crack growth rates and fracture surfaces were examined then compared between alloys and exposure conditions.