The nickel-based single crystal (SC) superalloys have been widely used to fabricate turbine blades and vanes due to their excellent high temperature mechanical properties, oxidation and hot corrosion resistance [1, 2]. Creep deformation was usually used to evaluate the higher temperature mechanical properties of superalloys. There are two types of creep test, one is the high temperature and low stress while the other is the low temperature and high stress [3-5]. The superalloys are strengthened by ordered g′ phase embedded in a continuous g matrix. The orientation of superalloys has a strong influence on the creep properties of superalloys [6-8]. It is important to study the deformation behaviors in superalloys with different orientation.

In this study, the creep deformation behaviors in [001] and [011] orientated SC superalloys under low temperature and high stress were studied (750 °C/750 MPa). The results show that the [001] superalloys has a much longer creep life (~1500 h, Figure 1a) than those of [011] superalloys (~70 h, Figure 1b). Analysis on fracture surfaces (Figures 1c and d) show that the [011] superalloys, having a regular cleavage plane, was fractured in a brittle way, while the [001] superalloys, having both cleavage plane and holes, fractured in a ductile way. TEM studies show that fracture of the superalloys was mainly caused by stacking fault cutting into the g′ phase (Figures 1e and f). As can be seen from Figure 1e, the stacking faults in [001] superalloys has a orientation angle, indicating more than one type slipping systems are activated during creep. On the other hand, only one type of stacking fault can be find in [011] superalloys (Figure 1f), indicating only one slipping system is activated.

Acknowledgement: This work was supported by Beijing Municipal Education Commission research project in grant KM201410005033, Beijing Nova program (Z141103001814108), NSFC (11327901), Beijing university of technology in 2014 young teachers ability of internationalization development plans.