Southern University

Study of Deformed High Temperature Materials Dislocation Substructure and Precipitate Agglomeration Features

Aerospace engine developments call for materials able to withstand temperatures up to 1000 deg. C at present and as high as 2000 deg. C in the near future. Such materials are expected to be progressively lighter, stronger and resistant to degradation during use. Current engines make use of Ni-base superalloys whose performance and tolerance of high temperatures can be improved by reducing the grain size and introduction of strengthening ceramic components. Ultrafine grain size is the keynote in the materials and composites contemplated for use. The IN 738 superalloy substrate material is an attractive candidate material due to its beneficial ordered intermetallic precipitate phase structure. Thermal behavior and microstructure development can be very useful in improved behavior of such TBC coated materials in service. This would depend on the grain size and the growth features of the parent matrix grains as well as strengthening precipitates during use. This project would study the behavior of selected alloys with nano-, and micron-meter size parent grains and delineate their precipitation, strengthening as well as degradation characteristics as a function of size and growth features of parent and precipitate grains. Suitable surface and processing modifications are planned to produce nano-size composite or layered coatings that would directly improve the resistance to various kinds of degradation and provide improvement in fatigue and creep resistance as well. Modeling of properties and behavior as a function of grain size variations and the interaction of dislocations within the alloys will provide valuable guidance toward property modifications and selection of processing techniques required to provide the needed tolerance to much higher temperatures than currently employed.