COMPUTER SIMULATION OF DEFORMATION BEHAVIOUR OF METALS AT LOW TEMPERATURE

BEING A THESIS PRESENTED

BY

NAEEM FAROOQUI

TO THE
UNIVERSITY OF BALOCHISTAN
QUETTA,

IN APPLICATION FOR

THE DEGREE OF DOCTOR OF PHILOSOPHY

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CERTIFICATE

It is a pleasure to certify that this is the bonafide work of Mr. Naeem Farooqui. In my opinion the thesis is suitable for the consideration for Ph.D degree in physics.

(DR. SYED MOHSIN RAZA)
Research Supervisor
and
Chairman
Department of Physics
University of Balochistan
Quetta.

Dedicated to my parents

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ABSTRACT

Reviewing the previous theories and models developed for dislocation/dislocations interactions, the relation for the creep rate is modified for low temperatures suggesting that the behaviour of stress relaxation rate is logarithmic in nature. A self-consistent stress relaxation model is discovered for the accurate measurement of activation energy in relaxation rate processes. A single barrier stochastic model of low temperature creep is developed defining dynamic recovery processes; shape of the dislocation is obtained by force balance equation, then using computer model the average dislocation velocity is calculated showing that it never becomes zero. A new force balance equation is used. The dislocations move by forming bulge, and unzipping tendency increases as the strength of the barrier increases contradict Foreman and Makin model (68); the average velocity of dislocations increases with the increase in the size of the array, but for small size the average velocity for each array will be different except where it is constant. Also the dislocations after covering a short distance reach a steady state velocity due to coupling effect between strong and weak barriers. Similarly the dislocation jump approaches an average or steady state velocity after travelling two or three times the insert distances. The deformation on slip plane is controlled by the rate of motion of the pileup nearly equal to the velocity of sound.

However strain enhancement and stress raising in the pre-yield band formation and dynamic recovery occuring at low temperatures show that a multibarrier stochastic model is needed for further studies.

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