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Elastic interaction between dislocation and interface: Force image effect in the ceramic bimetals (Al_2O_3 - AlN)

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Abstract : The Al_2O_3 and AlN materials are often used as electrical insulators (electronic substrates) also the case of pressure sensors where the aluminum nitride (AlN) is selected as the piezoelectric layer and the alumina (Al_2O_3) as a solid substrate insulating. In the absence of the effects of temperature, deformation and external stress, we are interested in this work to study the mobility of dislocations near the heterophase interface of bimetals based alumina (Al_2O_3) under the effect of the image force. These dislocations having a Burgers vector $b = 1/3 [11-20]$. The interface is defined by its plane parallel to the dislocation line and disorientation varies between 0 they are located in Al_2O_3 and 180° around the axis $[10-10]$. The image force must be calculated in the context of the anisotropic linear elasticity using the theorem of Barnett and Lothe and the Stroh formalism. $F_i = -E/d$, E is the elastic interaction energy. The results show that dislocation motion under the image force effect depends on the elastic and crystallographic properties of the materials constituting the bicrystals and even disorientation of the interface which has an effect on the intensity of the elastic interaction energy. The dislocations are repelled to the interface if the difference in shear modulus between the two materials is positive ($\mu > 0$), they are attracted to the interface in the opposite case ($\mu < 0$).

Keywords : dislocations, Image Force, Peierls stress, elastic anisotropy