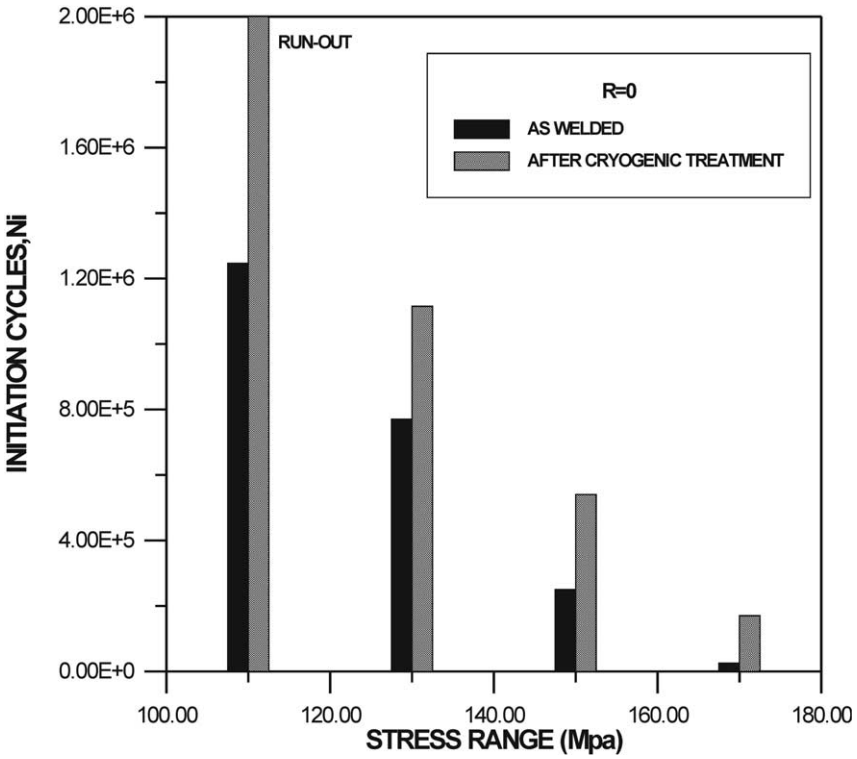

Fig. 3. Comparing crack initiation cycles of treated and non-treated joints.

3. Results and discussion

3.1. Crack initiation analysis

The crack initiation life 'N_I' was evaluated experimentally using the crack initiation criteria [6–9] used in welded joints. Here, in our investigations the initiation criterion is the number of cycles required to grow 0.5 mm length of crack in excess of its original LOP length under a particular stress range.

From Fig. 3, it can be seen that the initiation cycles of treated joints are almost double those of non-treated ones. It is well known that austenitic stainless steels are metastable at room temperature and the martensitic transformation occurs spontaneously like 'burst' below the M_s temperature in a cryogenic treatment. According to Bogers and Burgers [10], as the intersections of partial dislocations have a B.C.C-like stacking, these places can be the nucleation sites of martensite formation. Welding produces an enormous strain in the weld metal, which increases the dislocation density or number of these intersections. These places will act as strain nuclei for forming strain-induced martensites during cryogenic treatment. The nature of partial dislocations is particularly prominent in F.C.C materials [11]. Fig. 4(a) (TEM) shows the partial dislocations observed in non-treated samples. As a B.C.C structure has an incoherency to an F.C.C structure, the strain-induced martensites are expected to have an ability to increase the dislocation density. The accumulation of the dislocation motion results in the rearrangement of dislocations, stress concentration field is suppressed and crack initiation takes longer. Fig. 4(b) (TEM) shows typical stacking faults and high dislocation density structures observed in the treated specimens. Optical metallographic observation of the cryogenic treated weld metal did not reveal martensite in the microstructure. The micro-hardness data (Table 4) for the weld metals shows a pronounced increase between treated and non-treated