סמינר מחלקתי – הנדסת חומרים

הנכם מוזמנים בזאת לסמינרים מחלקתיים
אשר יתקיימו ביום ה', 21 במאי 2020 , כז' באייר תש"ף,
בשעה 14:00, דרך ה-ZOOM

Environmental behavior of ER70S-6 and 316L produced by wire arc additive manufacturing process (WAAM)

Tomer Ron

Supervisors: Prof. Eli Aghion and Dr. Amnon Shirizly
Department of Materials Engineering,
Ben-Gurion University of the Negev, Beer Sheva, Israel

Current additive manufacturing (AM) processes are mainly focused on powder bed technologies, such as electron beam melting (EBM) and selective laser melting (SLM). However, the main disadvantages of such techniques are related to the high cost of metal powder, the degree of energy consumption and the sizes of the components, which are limited by the dimensions of the printing cell. The aim of the present study was to evaluate the environmental behavior of carbon steel (ER70S-6) and 316L stainless steel produced by a relatively inexpensive AM method using wire arc additive manufacturing (WAAM) process. The general corrosion performance was evaluated by salt spray testing, immersion testing, potentiodynamic polarization analysis and electrochemical impedance spectroscopy while stress corrosion performance was characterized in terms of slow strain rate testing (SSRT) and high cycle corrosion fatigue in term of S-N curve. All corrosion tests were carried out in 3.5% NaCl solution at room temperature. In case of ER70S-6 alloy, the obtained results indicated that the general corrosion resistance of WAAM samples was quite similar to that of the counterpart ST-37 steel and their stress corrosion resistances were adequate. However, although the fatigue behavior of ER70S-6 and ST-37 in air was quite similar their corrosion fatigue was relatively different. This was related to inherent microstructural imperfections that can be present in ER70S-6 alloy in the form of printing porosity and lack of fusion that promote localized corrosion attack and consequent fatigue cracking. In case of 316L stainless steel, the corrosion performance of the printed - alloy was excellent and very similar to that of its counterpart wrought alloy. In addition, the stress corrosion performance of both alloys was also quite comparable. Altogether it was evident that WAAM technology can be considered as an adequate 3D production process with minor effect on corrosion performance.

סמינר מחלקתי – הנדסת חומרים

Determination of strength of small dislocation obstacles by shock (impact) loading

Guy Hillel

Advisors: Prof. Louisa Meshi[1], Prof. Eugene Zaretsky[2], Prof. Nahum Frage[1]

[1]*Department of Materials Engineering,* [2]*Department of Mechanical Engineering, Ben-Gurion University of the Negev, Beer Sheva, Israel*

Strength of small obstacles, i.e. clusters and/or precipitates, formed in the commercial PH 13-8 Mo steel and aluminum 6061alloy after the homogenization, quenching and aging for different duration has been determined based on their interaction with the shock wave, generated in the studied samples by planar impact. Such an impact generates in the material two waves. An elastic precursor wave propagating through the virgin material with velocity close to the longitudinal speed of sound is followed by a plastic wave moving much slower. As a result of an interaction of the elastic precursor wave with the structural defects, its amplitude decays with propagation distance *h*. The shear stress τ_{el}, associated with the precursor, is spent on plastic deformation, namely on the passage of the defects by dislocations. While the stress τ_{el} is higher than the defect's strength, the rate of the decay is high; the dislocation motion is opposed by phonon viscosity only. As soon as the stress τ_{el} becomes equal or lower than the strength of the defects, the rate of the decay becomes much slower. In this case, the dislocations should wait in front of an obstacle for the appearance of a thermal fluctuation, which will aid the passage through the defect. The defect`s strength is equal to the stress τ^* corresponding to the transition from one regime of decay to another. The rate of decay at thermally-activation regime allows one to determine defect dimensions. Transmission Electron Microscopy (TEM/HRTEM) investigation was conducted in order to compare the obstacle dimensions, estimated based on the shock testing, with those measured directly from the images and in order to specify geometry/distribution of these obstacles. The values obtained by the two approaches were found to be in satisfactory agreement. The results prove that suggested shock technique may be considered as a useful tool for studying dislocation/defect interaction in a wide variety of strengthened alloys.