Foreign Winner		◄
First Winner	Rank	◄
Basic Sciences	Category	◄
Prof. Digby Macdonald	Researcher	◄
U.S.A	Nationality	◄
Pennsylvania State University	University	◄
Development of the point defect model for prediction of localized corrosion	Project Title	◄
Abstract		◄

Over the past twenty five years, I have developed the Point Defect Model (PDM), which provides an atomic scale description of passivity in reactive metals and alloys (see the attached publications). This phenomenon, in which the metals are kinetically stable in contact with corrosive environments, allows the reactive metals (Fe, Ni, Cr, Ti, Zr, Cu, Al, etc) to be used in the fabrication of machines and hence is a necessary condition for the development of our metals-based civilization. In my work, I have reduced the conditions that must be met to a single equation, which embodies all conditions that lead to passivity. I have also expanded the PDM into Damage Function Analysis (DFA), which is the only fully deterministic method of predicting the accumulation of localized corrosion damage in industrial systems. To date, DFA has been successfully applied to predicting damage due to pitting, stress corrosion cracking, and corrosion fatigue in low pressure steam turbines; to pitting in condensing heat exchangers and in the neutrino detection experiment in Sudbury, Ontario, Canada (pitting of the nickel detection tubes); and is currently being applied to the failure of oil/gas transmission pipelines.

Khwarizmi International Award