

EXAMINATION OF MECHANISTIC PATHS IN ORGANIC SOLVENTS ON THE PASSIVITY AND BREAKDOWN OF COMMON ALLOYS

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The type and structure of the organic functional group influence the reactivity of metals in organic solvents. An organic solvent transports the aggressive reactants and the products formed during the corrosion process. The type of solvents in use and their solvation properties affect the solubility of these reactants; many different physical and chemical interactive forces occur during solvation. These different interactive forces play a significant part on the mechanistic paths that, in turn, can affect the passivity of different alloys in a given organic solvent or mixtures of two or more organic solvents.

Organic solvents can be classified into three general groups. The first group are nonpolar aprotic solvents which includes aromatic and aliphatic hydrocarbons and symmetrical halogenated hydrocarbons. Solvation in these systems occurs by relatively weak van der Waals-London forces. The second organic group are dipolar aprotic solvents that display electrostatic forces due to ion-dipole and dipole-dipole interactions. The last group of organic solvents is protic solvents which include organic acids, alcohols, amines, amides, and water. Solvation in protic solvents occurs through dipole-dipole interaction, ion-dipole interaction, and hydrogen bonding. The protic or aprotic character of the solvent is determined by the ability to provide protons. Protic media

contains active hydrogen protons; aprotic solvents do not.

This paper will summarize previous results of different alloys in aprotic organic solutions and mixtures by exploring various mechanistic pathways available for passivation. Numerous factors influence the stability and character of the films formed on metals and alloys in neutral dipolar, aprotic solutions such as propylene carbonate (PC), tetrahydrofuran (THF), dimethyl sulfoxide (DMSO), and dimethoxyethane (DME). The character of the passive films on metals and alloys such as Fe, 1018 carbon steel, Ni, Ni-200, and 304 stainless steel and environmental contributions will influence the possible mechanistic paths and the potential regions where passivity is effective for these alloys. The passivity of alloys in organic solutions is complex; water increases this complexity by its influence of organic passivation mechanisms and/or by its enhancement of oxide/oxyhydroxide formation. Factors that may contribute to passivity in these solutions are: (1) composition and stability of the air-formed film; (2) the presence of surface-active sites such as sulfides; (3) functional group of the organic solvent; (4) concentration of the organic solvent(s); (5) composition and concentration of the supporting electrolyte; (6) water concentration; (7) other solution impurities from the solvent or electrolyte; and (8) potential.