Competition between diffusion, growth and corrosion in passive layers. Cellular automata simulation results in a 2D system.

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In this poster we present the simulation results of the corrosion and passive layer growth process on a corroding surface. Working on the mesoscopic scale we consider three main processes - dissapearence of the corroded material at the corrosion front, redistribution of the corrosion products across the layer via a diffusion process and the growth front advancement due to precipitation of the corrosion products at the growth front. The crucial parameter for the outcome of our simulation is the ratio of the diffusion rate for the diffusion process to the corrosion rate. In the diffusion controlled regime when diffusion is small compared to the corrosion rate we recover the parabolic growth law for the corrosion front. For the morphology of the corrosion front the diffusion has a stabilizing effect on the front roughness. In the diffusion controlled regime the front is flat and smooth on the length scales down to the lattice constant of the square lattice used for the simulation. When diffusion is fast enough the corrosion front gets roughned by the random corrosion process and seems to attain a constant roughness depending on the ratio of the corrosion rate and the diffusion rate. In the limit of infinitely fast diffusion and for the time scales before the imposition of the diffusion control the corrosion front development follows that of the Eden model and the scaling laws for this model are reproduced. The imposition of the diffusion controlled regime leads to a remarkable decrease of the corrosion rate as compared to the initial corrosion rate. The practical implications of this observation are discussed.