Two-species reactive lattice gases on random catalytic chains: Annealed versus quenched disorder

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Catalytically activated reactions involve particles that react only in the presence of another agent, which is called a catalyst. Such catalytic processes are widespread in the nature and different technological applications. To study the properties of equilibrium and out of equilibrium properties of such reactions is devoted a lot of attention. In particular, it is known that the thermodynamic properties of the monolayers of adsorbed molecules, formed in the course of catalytically-activated reactions, are very similar to the properties of the adsorbates modelled by athermal hard core lattice gases. Therefore we study a lattice-gas model of two species particles and focus on the equilibrium properties of a catalytically activated $A + B \to 0$ reaction. Particles A and B, involved in the reaction, being in thermal contact with their vapor phases acting as reservoirs and may adsorb onto substrate and desorb from it. This process taking place on a substrate with some non-uniform catalytic properties. We consider the simplest case of reactions on a one-dimensional chain with some structural elements of which have catalytic properties. We consider that some bonds of a chain are catalytic and other case that some sites are catalytic. For both cases these structural elements placed randomly with mean concentration p. We consider two types of disorder in placement of catalytic elements when disorder can be viewed as annealed, and other case with a quenched random distribution of the catalytic elements. For both models we obtain the thermodynamic functions, namely the disorder-averaged pressure, particles density and the compressibility and compare obtained results for both types of disorder.