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Improved modeling of the percolation behavior of conductor-insulator composites with modulated granular size distributions
KAZUHITO SHIDA, RYOJI SAHARA, MADHVENDRA TRIPATHI, HIROSHI MIZUSEKI, YOSHIYUKI KAWAZOE, Institute for Materials Research, Tohoku university — The percolation threshold shows a universality that may cause a strict limit on the mixture ratio of composite materials. When particles A and B are randomly filling a material and A must form an interconnected cluster (e.g. for electrical conduction), there is a strict limit on the fraction of A (for example, 0.598 in 2D). A solution to solve this problem is introducing size distribution on B particles (N.Lebovka J.Phys.D (2006) and WJ Kim J.Appl.Phys (1998)). However, theoretical understanding of this phenomenon is still in a quite immature stage despite of its importance in applications. We report the reduction of the percolation threshold observed in square lattices with a number of binary size distributions, as well as our approach toward semi-empirical theoretical method, that is based on an enumeration of local particle configurations generated in a totally random manner. This is a notable advance because most of previous theoretical methods were considering only limited combination of configurations, in which the positions of the B particles are not fully randomized.

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