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Parameter optimization of sub-35 nm contact-hole fabrication using particle swarm optimization approach.

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Summary: The major research focus on integrated circuits (ICs) mainly deals with increasing circuit performance and functional complexity of circuit. The lithography process is the most critical step in the fabrication of nanostructure for integrated circuit manufacturing. The most important variable in the lithography process is the line-width or critical dimensions (CDs), which perhaps is one of the most direct impact variables on the device performance and speed. This study presents a hybrid approach combining Taguchi's robust design, back-propagation neural network modeling technique and particle swarm optimization (PSO) for sub-35 nm contact-hole fabrication in the lithography process. The BP neural network is employed to model the functional relationship between the input parameters and target responses. Particle swarm optimization is adopted to optimize the parameter settings through the well-trained BP model, where each particle is assessed using fitness function. The proposed PSO algorithm applies the velocity updating and position updating formulas to the population composed of many particles such that better particles are generated. Compared with realistic fabricated and measured data, this approach can achieve the optimal parameter settings for minimized CDs or target CDs. Meanwhile, it reduces the CD variation through the design of experiment. The experimental results show that the proposed approach dealing with the process modeling and parameter optimization demonstrates its feasibility and effectiveness for sub-35 nm contact-hole fabrication.

Keywords: critical dimension; back-propagation neural network; particle swarm optimization (PSO)
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