Incorporation of Machine Learning in the Automation of Atom-Scale Device Fabrication

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Scanning Probe Lithography has proven a strong candidate for atom-scale device patterning[1]. Until recently, full automation of the lithography process has been hindered by the extensive user interaction that scanning probe microscopes require. We present two recent works which utilize deep neural networks to achieve full automation. The first[2] demonstrates *in situ* probe tip conditioning where the tip quality is assessed by a neural network. The second shows atom-scale patterning of dangling bonds on hydrogen-terminated silicon which uses neural networks to locate viable patterning sites.

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[1] Huff, T., Labidi, H., Rashidi, M., Livandaru, L., Dienel, T., Achal, R., Vine, W., Pitters, J., and Wolkow, R.A. Binary Atomic Silicon Logic. *Nature Electronics* 1: 636-643, 2018

[2] Rashidi, M. and Wolkow, R.A. Autonomous Scanning Probe Microscopy *in Situ* Tip Conditioning through Machine Learning. *ACS Nano* 12: 56, 2018