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Neutral Atom Lithography Using a Bright Metastable Helium Beam[1] CLAIRE ALLRED, JASON REEVES, CHRIS CORDER, HAROLD METCALF, Stony Brook University — We have performed neutral atom lithography using a bright beam of metastable 2^3S_1 Helium (He*) that is collimated with the bichromatic force, followed by three optical molasses velocity compression stages. Because bichromatic collimation makes such an intense He* beam, our exposure time is measured in minutes instead of hours. We have exploited the focusing and channeling of the He* beam into lines by the dipole force the atoms experience while traversing a standing wave of $\lambda = 1083$ nm light tuned 500 MHz below the $2^3S_1 \rightarrow 2^3P_2$ transition. Focused He* atoms damage the molecules of a self assembled monolayer (SAM) of nonanethiol by depositing their 20 eV of internal energy on its surface. The undisturbed SAM then protects a 200 Å layer of gold that has been evaporated onto a prepared Silicon wafer from a wet chemical etch. Samples created with this method have an edge resolution of 63 nm that was observed using an atomic force microscope. The lines are separated by $\lambda/2$ and cover the entire exposed length of the substrate, about 3 mm. They are about 3 mm long, corresponding to about twice the beam waist of the laser standing wave. Thus there are $\sim 6\times10^3$ lines of length $\sim 1500\lambda$. These results agree with our numerical simulations of the experiment.

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Harold Metcalf
Stony Brook University

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