Interferometrically Evaluating Patterning Accuracy of EBL/KOH Ultraviolet Gratings for Astronomy

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Ultraviolet (UV, 900-2000Å) astronomical spectra trace the most common elements in the Universe (e.g., H, He, O, C, N) in many phases simultaneously, UV grating spectrometers hence offer unique insights into astrophysical systems and the impacts of their evolution. UV spectroscopic instruments require the use of specialized optics (gratings) with modest feature sizes (100's of nm). Electron-beam lithography (EBL) with potassium hydroxide (KOH) wet etching shows potential to be an ideal patterning process for creating these gratings.

Determining the ideal grating design parameters for specific science objectives is an essential step in formulating a UV mission. To this end, we use grating simulation software to explore a grating-parameter space and determine the key performance expectations for gratings for next-generation UV space instruments and spectrometers. Using these results, we designed an UV grating optimized for measuring exoplanetary atmospheric loss. We have used the EBL/KOH-patterning process to create a prototype grating and measured it interferometrically to empirically determine the patterning accuracy. These measurements will provide vital feedback about the quality of our grating fabrication processes and inform us of potential areas of improvement.

Here, we present the results of our design optimization, the expected performance of our prototype grating, and evaluate patterning accuracy of our EBL/KOH development process.