Simulations of plasmas driven by laser wavelengths in the $1.064 - 10.6 \, \mu m$ range as future extreme ultraviolet light sources

Stan J.J. de Lange,1,2 Diko J. Hemminga,1,2 Oscar O. Versolato,1,2 and John Sheil 1,2

1 Advanced Research Center for Nanolithography, Science Park 106, 1098 XG Amsterdam, The Netherlands
2 Department of Physics and Astronomy, and LaserLaB, Vrije Universiteit Amsterdam, De Boelelaan 1081, 1081 HV Amsterdam, The Netherlands

We characterize the properties of extreme ultraviolet (EUV) light source plasmas driven by laser wavelengths in the $\lambda_{\text{laser}} = 1.064 - 10.6 \, \mu m$ range and laser intensities of $I_{\text{laser}} = 0.5 - 5 \times 10^{11} \, \text{W cm}^{-2}$ for $\lambda_{\text{laser}} = 1.064 \, \mu m$. Detailed numerical simulations of laser-irradiated spherical tin microdroplet targets reveal a strong laser-wavelength dependence on laser absorptivity and the conversion efficiency of generating EUV radiation. For $\lambda_{\text{laser}} = 1.064 \, \mu m$ irradiation, the increase in in-band radiation with increasing laser intensity is offset by only a minor reduction in conversion efficiency. Radiative losses are found to dominate the power balance for all laser wavelengths and intensities, and a clear shift from kinetic to in-band radiative losses with increasing laser wavelength is identified. Yet, with increasing laser intensity, such a shift is absent. We find that the existence of a maximum conversion efficiency, near $\lambda_{\text{laser}} = 4 \, \mu m$, originates from the interplay between the optical depths of the laser light and the in-band EUV photons for this specific droplet-target geometry.