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Power scaling of extreme ultraviolet frequency combs to the mW level per high harmonic[1] GIL PORAT, CHRISTOPH M. HEYL, STEPHEN B. SCHOUN, CRAIG BENKO, JILA, NIST and the University of Colorado, NADINE DRRE, JILA, NIST, the University of Colorado and University of Vienna, Faculty of Physics, VCQ QuNaBioS, KRISTAN CORWIN, Department of Physics, Kansas State University, JUN YE, JILA, NIST and the University of Colorado — Recently, a demonstration of direct frequency comb spectroscopy in the extreme ultraviolet (XUV) has been performed, however further advancement is curtailed due to the limited XUV comb power of ∼0.2 mW per harmonic. The method for generating XUV combs is via intracavity high harmonic generation (HHG). The main challenge for further power scaling of XUV comb is the detrimental effect of plasma, generated in the HHG process, on intracavity power buildup and on phase-matching. Due to the laser's high repetition rate, this plasma has a cumulative effect over multiple pulses as each production takes much longer than the $<$10ns interval between pulses to clear the generation volume. We address the steady-state plasma problem by adding a light carrier gas (helium) to a heavy generation gas (xenon). This increases the gas jet forward velocity, thus reducing the number of intracavity laser pulses that interact with the same atom/ion. Furthermore, we experimentally demonstrate that by increasing the time between consecutive pulses, while keeping the same intensity, the HHG conversion efficiency per pulse is enhanced. This is an indication of improved phase-matching, making phase-matched intracavity HHG possible. We have achieved record powers of 1.2 mW at 97 nm and 0.53 mW at 63 nm.

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