

Ultrabroadband Mid-Infrared Supercontinuum Generation at 5 kHz by Electric Field Assisted Two-Color Filamentation in Air

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We demonstrate the stabilization of mid-infrared (MIR) supercontinuum pulses generated by two-color filamentation through the application of a static DC electric field. By applying a strong electric field to the laser filament using a Rogowski electrode, we observed significant improvements in both pulse intensity and pointing stability at high positive voltages. Specifically, the instability of the intensity was reduced from $\sim 3.5\%$ to $\sim 1.3\%$, while the instability of the beam pointing along the vertical axis – the direction of the applied field – was also reduced from ~ 0.020 mrad to ~ 0.005 mrad. These enhancements are attributed to the spatial separation of ions and electrons within the plasma, which suppresses recombination and subsequent thermal-induced refractive index fluctuations. The improved pulse characteristics were successfully inherited by upconverted MIR spectra, with the integrated spectral stability improving from $\sim 6.0\%$ to $\sim 3.3\%$. Finally, we demonstrate that these stabilized pulses greatly suppress noise in MIR hyperspectral imaging via sum-frequency generation in a thin GaSe film, resulting in significantly enhanced image quality.