SCALING OF YB-FIBER FREQUENCY COMBS

AXEL RUEHL, ANDRIUS MARCINKEVICIUS, MARTIN E. FERMANN and INGMAR HARTL, *IMRA America Inc., 1044 Woodridge Avenue, Ann Arbor, Mi 48105-9774, USA.*

Immediately after their introduction in 1999, femtosecond laser frequency combs revolutionized the field of precision optical frequency metrology and are key elements in many experiments. Frequency combs based on femtosecond Er-fiber lasers based were demonstrated in 2005, allowing additionally rugged, compact set-ups and reliable unattended long-term operation. The introduction of Yb-fiber technology led to an dramatic improvement in fiber-comb performance in various aspects. Low-noise Yb-fiber femtosecond oscillators enabled a reduction of relative comb tooth linewidth to the sub-Hz level[a] as well as scaling of the fundamental comb spacings up to 1 GHz[b]. This is beneficial for any frequency-domain comb application due to the higher power per comb-mode. Many spectroscopic applications require, however, frequency combs way beyond the wavelength range accessible with broad band laser materials, so non-linear conversion and hence higher peak intensity is required. We demonstrated power scaling of Yb-fiber frequency combs up to 80 W average power in a strictly linear chirped-pulse amplification schemes compatible with low-noise phase control[c]. These high-power Yb-fiber-frequency combs facilitated not only the extension to the mid-IR spectral region[d]. When coupled to a passive enhancement cavity, the average power can be further scaled to the kW-level opening new capabilities for XUV frequency combs via high-harmonic generation[e]. All these advances of fiber-based frequency combs will trigger many novel applications both in fundamental and applied sciences.

[a] Schibli et al., Nature Photonics **2** 355 (2008).
[b] Hartl et al., MF9 in Advanced Solid-State Photonics. 2009, Optical Society of America.
[c] Ruehl et al., AWC7 in Advanced Solid-State Photonics. 2010, Optical Society of America.
[d] Adler et al., Optics Letters **34** 1330 (2009).
[e] Yost et al., Nature Physics **5** 815 (2009).