bounces, affect negligibly the contrast of the pulse (see pulse in logarithmic scale, on Fig. 3), leaving its shape and duration almost unchanged. The main practical limitations for scaling of output power appeared to be the thermal effect and damage threshold of intracavity elements, including HDM. We have compared temperature changes on the surface of available mirrors at 47 W in a continuous wave operation of the laser. The output coupler has reflectivity of 94.5%, thus the intracavity power is by factor of 18 larger than the output power of the oscillator. We have measured temperature of mirrors around beam spot with thermal camera. Both HDM1 and HDM2 demonstrate relatively low temperature: maxima 311 K and 314 K, respectively. In case we switch power off, the temperature is drop to 298 K for whole surface of the mirror. The high-reflectance mirror (quarter-wave stack) made from the same alternating materials as HDM has maximum temperature of 312 K. The temperatures of all available mirrors have changed in the range from 311 K to 350 K.

HDM2 mirrors were successfully implemented in Kerr-lens mode-locked Yb:YAG thin-disk oscillator [7]. It delivers 270-fs 1.1-μJ pulses at an average power of 45 W and a repetition rate of 40 MHz with an optical-to-optical efficiency of 25% (see Fig. 4).

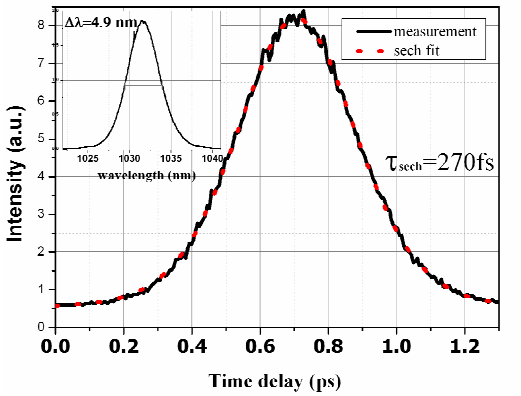

Fig. 4. Autocorrelation measurement and spectrum at 45W output power and 14% output coupler transmission. Time-bandwidth product is 0.36 (ideal 0.315).

4. Conclusions and discussion

For the first time, we demonstrate HDMs with GDDs as high as –3000 fs^2 and –4000 fs^2 at a central wavelength of 1030 nm ±5nm. The measured reflectance are >99.91% and >99.97% for HDM1 and HDM2, respectively. The novel robust synthesis technique was applied to the design of a high-dispersive mirror. The HDM2 were successfully implemented in an Yb:YAG disk oscillator with 270-fs pulses at an average power of 45 W and a repetition rate of 40 MHz. Beyond high-power oscillators the unique combination of high dispersion, low losses and negligible thermal effects are also expected to benefit enhancement cavity technology as well.

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