(texture) of lines written in opposite directions, with a line written in one direction being rougher than a line written in the reversed direction (Fig. 2a).

An intriguing result is the observation of *different* textures in the processed material for laser polarizations perpendicular and parallel to the movement of the sample *in one direction* and the *same* textures for two polarizations when writing in the *opposite* direction (Fig. 2a).

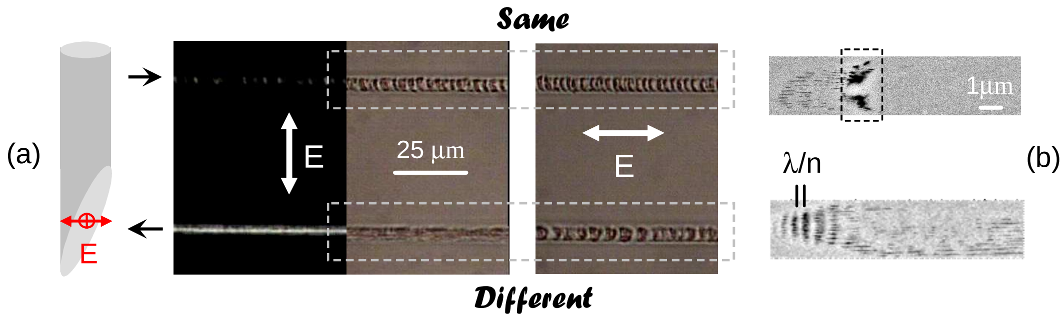

Figure 2 (a) Optical microscope images of the lines written with orthogonal polarizations with 500 kHz repetition rate, writing speed 250 μm/s and pulse energy 0.9 μJ. The difference in texture for two polarizations is observed only for one writing direction. The tilted front of the pulse along writing direction is shown. (b) SEM images of cross sections of lines written with polarization perpendicular to writing direction are also shown. The region of collateral damage is marked with black dashed line.

The SEM images of the cross-sections of the lines, along the light propagation, revealed a different texture in the lines written in opposite directions (Fig. 2b). Remarkably, the nanograting of about 300 nm period, which is responsible for the form birefringence of irradiated regions, can be seen only in the initial part of cross sections of lines written in one of two directions. This small area is followed by one with a collateral damage due to thermal effect, which correlates with a weak birefringence of these lines. It is also observed, that in almost entire cross sections of the lines, written in opposite direction, there is the nanograting along the direction of light polarization with the period of about 250 nm together with the additional periodicity, along the direction of light propagation, of about 720 nm, which is of the wavelength of light (λ/n, $\lambda = 1045$ nm, n = 1.45) (Fig. 2b). These lines demonstrate no evidence of the collateral thermal damage and much stronger birefringence (Fig. 2a).

The puzzle of the writing direction anisotropy is explained by the anisotropy of the frequency distribution (frequency chirp) and corresponding tilt in the intensity distribution in the front of the pulse [6]. It is known, that in the presence of intensity gradients, the charges (e.g. electrons) experience the pondermotive force (light pressure), which expels the electrons from the region of high intensity [7]. By moving the beam, the pondermotive force in the front of the pulse will trap and displace the electrons along the direction of movement of the beam and only in one direction corresponding to the tilt in the intensity distribution (we refer to this phenomenon as the “quill effect”). Further support of the proposed mechanism is the evidence of different textures of modified material for writing with light polarizations parallel and perpendicular to the movement in one of writing directions (Fig. 2a). This observation is explained by the difference in boundary conditions for two orthogonal polarizations at the interface of the *tilted pulse front along the writing direction.* In conclusion, it is remarkable that a laser beam, one of the most modern writing tools, could be used for calligraphic inscription similar to writing with a quill pen, which is based on the anisotropy of a quill’s tip shape.

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