ELECTRONIC SUPPLEMENTARY INFORMATION

Conventional elastomers doped with benzophenone derivatives as effective media for all-optical fabrication of tunable diffraction elements

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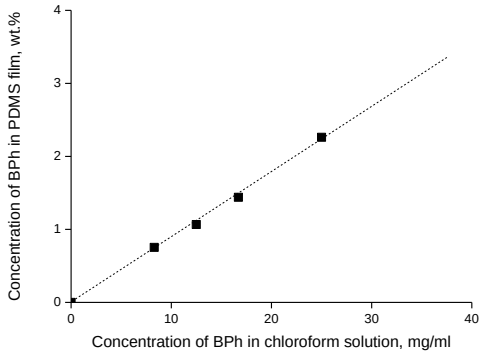
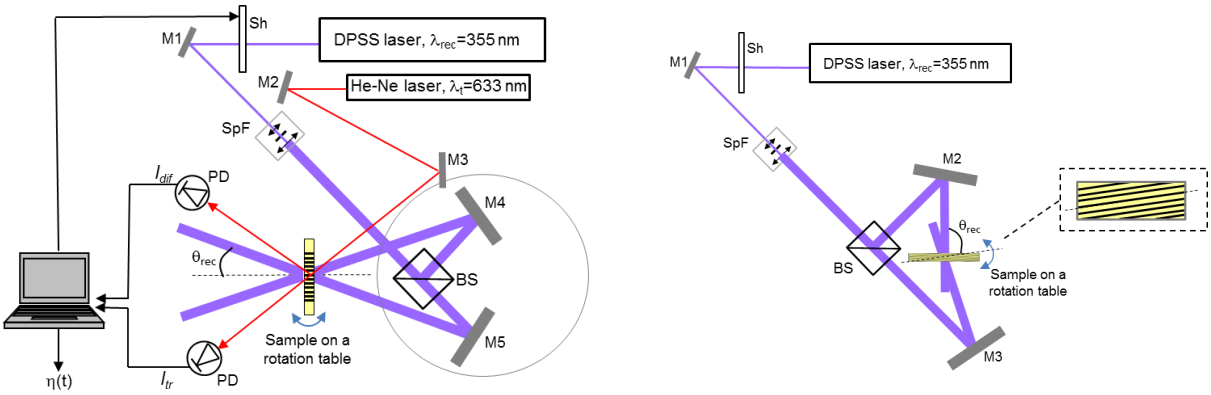


Fig. S1. Dependence of **BPh** concentration in **PDMS** film (thickness – 220 μm) via its concentration in chloroform solution used for the immersion.



a b

Fig. S2. Scheme of the holographic setups for recording of transmission (a) and reflection (b) gratings: BS – beam splitter; M_i – mirror; SpF – spatial filter; Sh – shutter; PD – photodiode.

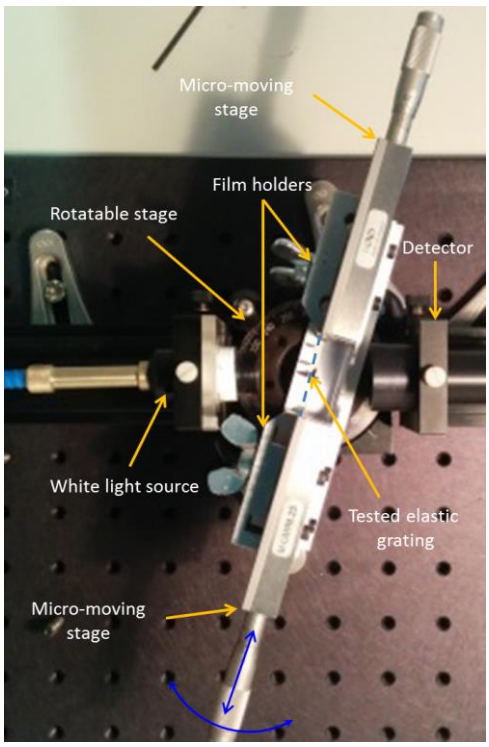
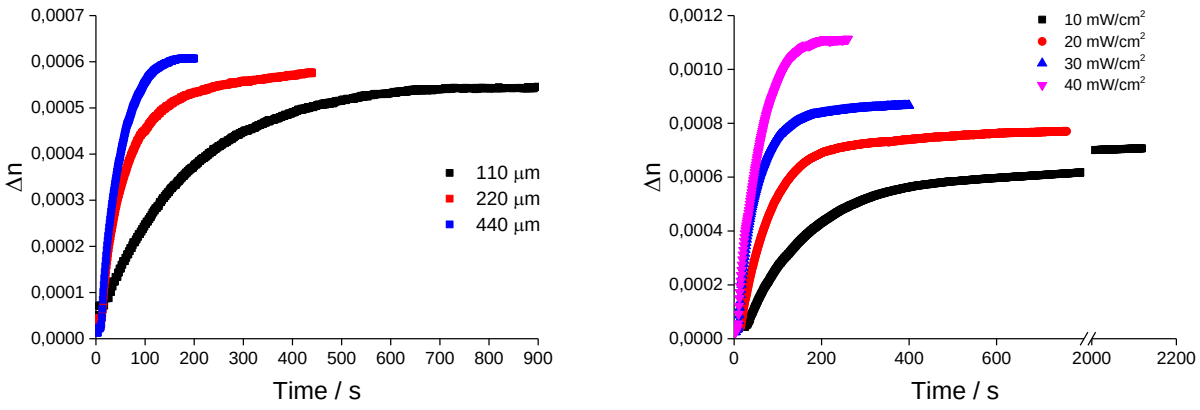


Fig. S3. Setup for the investigation of spectral properties of the elastic VDGs.



a b

Fig. S4. a) Kinetics of the VDGs recording in the films (**PDMS** doped with 1.5 wt.% of **BPh**) of different thickness; b) kinetics of the VDGs recording in elastic film (**PDMS** with 3 wt.% of **BPh**) at different light intensity. Film thickness – 220 μm. In both cases the grating period is 853 nm.

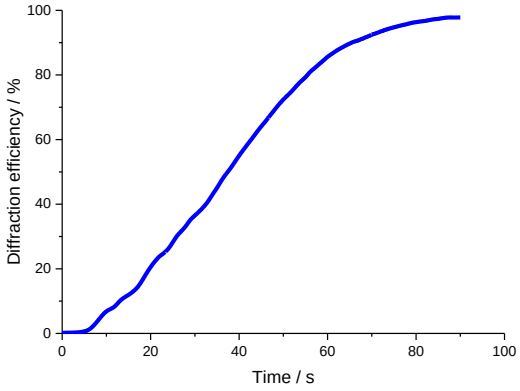


Fig. S5. Recording kinetics of the VDG in the 440 μm **PDMS** film doped with 1.5 % of **BPh**. Grating period – 853 nm.

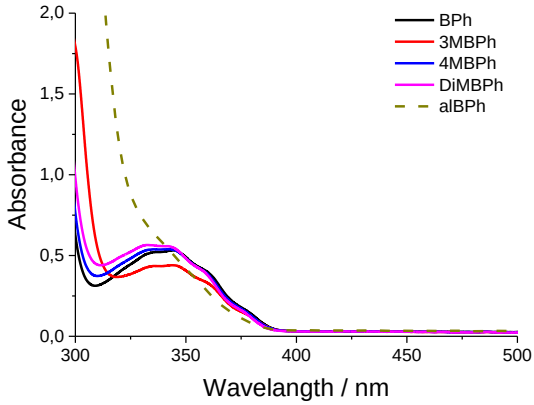


Fig. S6. Absorbance spectra of 440 μm thick **PDMS** films doped by **BPh**, **3MBPh**, **4MBPh**, **DiMBPh** with concentration of 2 wt.% and by **alBPh** with concentration of 1 wt.%.

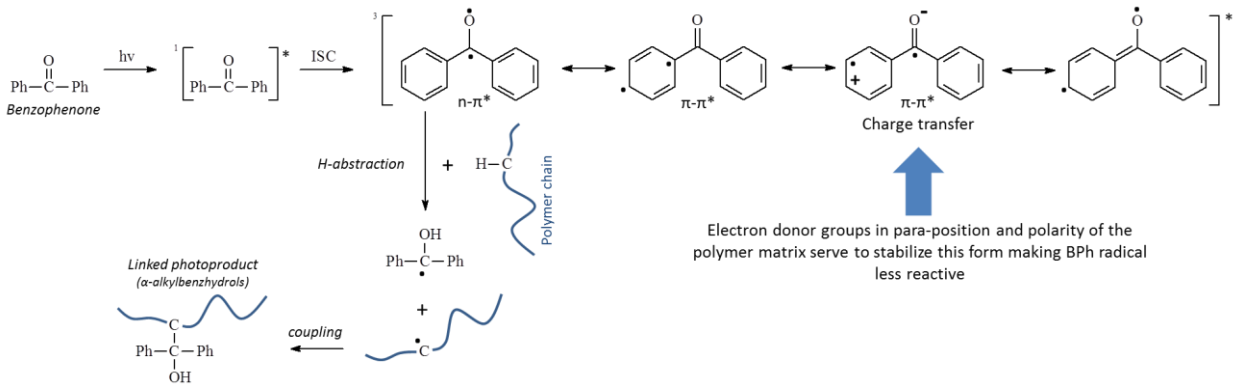
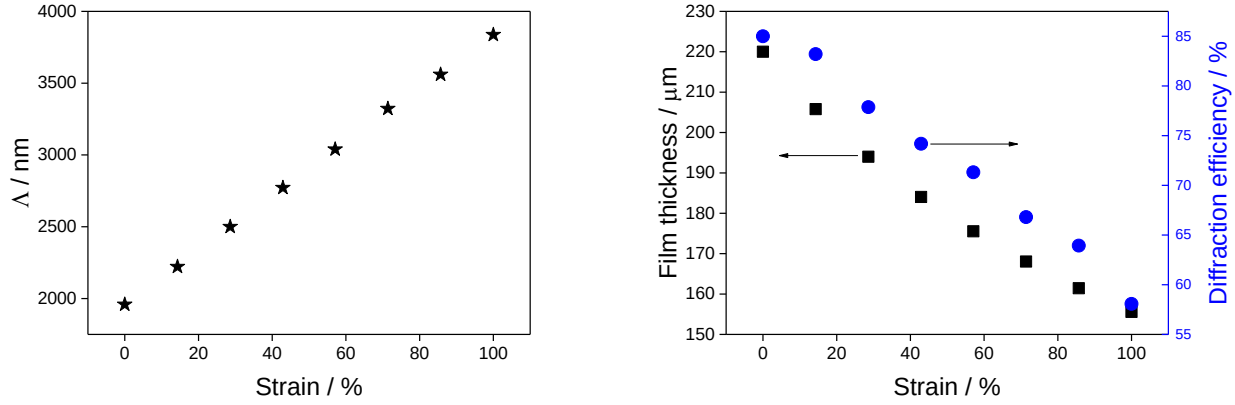


Fig. S7. The scheme of photo-attaching of **BPh** molecules to the polymer chain. Possible n-π* and π-π* triplet exited forms of **BPh** are given in the bracket.

The reactivity of benzophenone derivatives is dictated by the lowest energy level of triplet exited state. Usually n-π* triplet state is more effective then π-π* state, and as a consequence, all factors leading to the stabilization of π-π* charge transfer form of **BPh** will result the decrease of its reactivity that makes **BPh** unreactive. [1] There are at least two different ways to influence on the stabilization of charge transfer form: i) introduction of electron donors in para-position of aromatic ring which decreases electrophility of carbonyl group; ii) polar solvent (polar environment) will also stabilize the polar charge transfer form. Both these factors reduce the **BPh** reactivity in H-abstraction reactions.



a b

Fig. S8. a) The period of the VDG via a strain; b) diffraction efficiency via a strain measured at the Bragg angle and the corresponded values of film thickness estimated as previously described. [2] Grating period – 1.95 µm. Film thickness – 220 µm. **PDMS** film doped by 2 wt.% of **BPh**.

[1] a) G. Porter, P. Suppan, *Trans. Faraday Soc.*, **1965**, *61*, 1664; b) A. Singh, A. Bhasikuttan, D. Palit, J. Mittal, *J. Phys. Chem. A*, **2000**, *104*, 7002; c) S. Christensen, M. Chiappelli, R. Hayward, *Macromolecules*, **2012**, *45*, 5237.
[2] A. Ryabchun, M. Wegener, Y. Gritsai, O. Sakhno, *Adv. Optical Mater.* **2016**, *4*, 169.

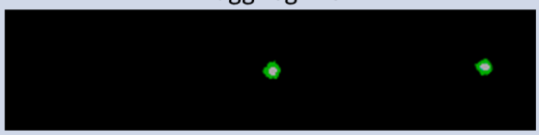
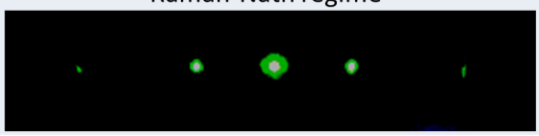
Diffraction Pattern	Strain	Period, μm	Thickness, μm	Q factor
Bragg regime 	0%	0.85	68	250
Raman-Nath regime 	170%	2.32	41	20

Fig. S9. Demonstration of the switching between the Bragg and the Raman-Nath regimes using **SEBS** VDG (1 wt.% of **BPh**). Grating period – 0.85 μm; films thickness – 68 μm. Incident angle of 532 nm laser beam is 18.2° in the case of the Bragg regime and normal to the grating surface in the case of the Raman-Nath regime. The Q-factor was calculated according to the following formula:

$$Q=2\pi\lambda_t d/n\Lambda^2$$

where λ_t is wavelength, d is the thickness of the grating, n is the refractive index of the material, Λ is the grating period.

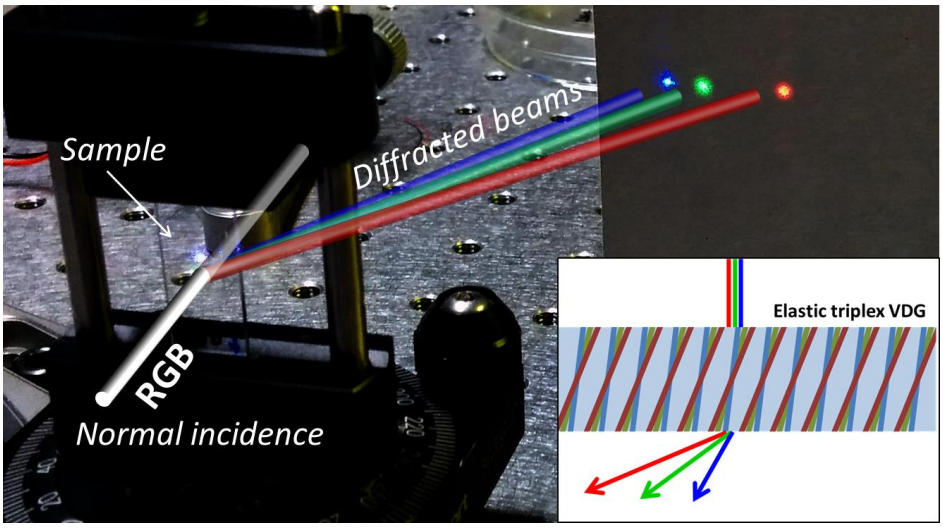


Fig. S10. The image and a scheme (inset) of diffraction the RGB laser beams by a triplex slanted VDG. Grating period – 853 nm; film thickness – 220 μm.

Three slanted VDGs have been sequentially inscribed in the photoactive **PDMS** layer with the thickness of 220 μm. A multiply grating recording can be carried out either by the dividing of a dynamic range of the material (i.e., time of holographic exposure) or by a stepwise doping of the elastomeric film with fresh photoactive compound after each recording step. Before each exposure step the sample was rotated at a proper angle concerning to the normal axis of the sample. The slant angles of the grating fringes were adjusted in order to provide simultaneously a normal incidence of the 475, 532 and 633 nm laser beams on the grating of 853 nm period. The corresponding slant angles were calculated as: 16.2, 18.2 and 21.8°.

Video S1. [*attached as a separate file*] Tuning of the in-coupled laser light at a mechanical strain of the VDG coupler (slanted elastic volume grating). The studied grating was tested using three (RGB) laser beams all aligned along one axis and incident at the angle of 14.5° on the sample in order to in-couple firstly a blue light (475 nm) into the films at 0% strain.