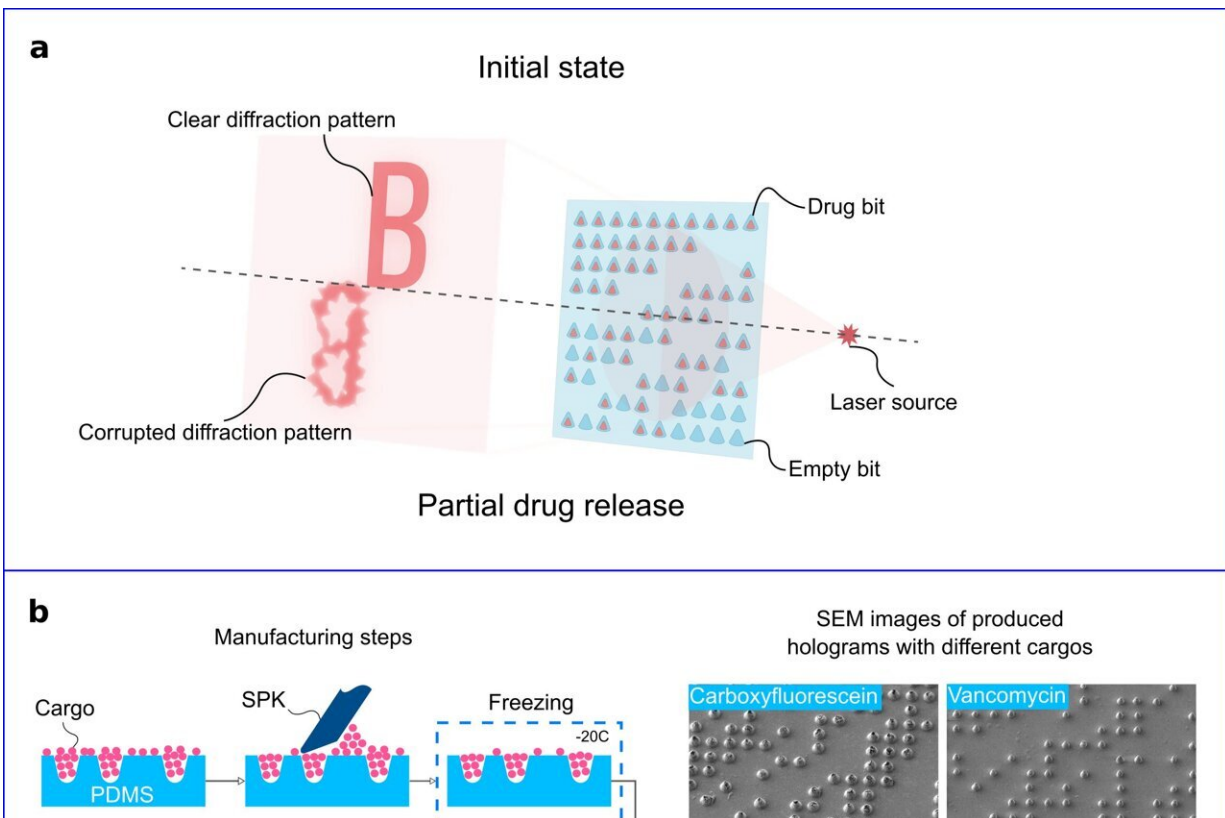


Biocompatible binary hologram with drug-elution capabilities

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a) graphical representation of the operation of a binary hologram as a drug release indicator. As the drug elution goes the far-field diffraction patterns corrupts in a certain way that could be used to qualitatively track the amount of eluted cargo. b) the main stages of manufacturing such holograms in a lab-scale quantities. The critical steps in the manufacturing process are excess powder removing and freezing. Freezing allows for formation of condensation onto the surface of the PDMS mold. This condensate dissolves the small amount of excess powder left after the initial scurrying process. This thin layer of water

solution could be easily removed. The result is almost no redundant powder left in-between the cargo bits that could corrupt the far-field diffraction pattern. The physical dimensions of the well in the mold and the physical and chemical properties of the loaded powder govern the size of a cargo bit. Different water solvable bioactive substances such as antibiotics, dyes etc. could be used in this process to fit the desired needs. Credit: Arkady S. Abdurashitov, Pavel I. Proshin, Valery V. Tuchin, Gleb Sukhorukov

Holographic devices are used for security enhancement, entertainment, 3D display technologies and augmented reality and more. Due to their high information capacity, the ability to track ongoing external processes by assessing changes in the diffraction pattern, as well as well-established and simple methods for their production from various materials, holograms are finding new applications in various fields.

In a new paper published in *Light: Advanced Manufacturing*, a team of scientists, led by Professor Gleb Sukhorukov from Laboratory of Remote Controlled Biomaterials, V. Zelman Center for Neurobiology and Brain Rehabilitation, Skolkovo Institute of Science and Technology, Moscow and co-workers have developed a new manufacturing routine for an application of binary amplitude-only holograms. The proposed direct drug printing (DDP) technique works with water-soluble substances but can be adapted to other types of drugs, if necessary. Numerically and experimentally, they have shown the ability of the diffraction pattern to reflect the amount of cargo remaining in the hologram after a certain amount of time. This unique feature of holographic packaging systems can potentially be used in a wide range of tasks requiring monitoring of the amount of emitted substance.

"We introduce an additive approach of producing bio-compatible DOEs using direct drug printing (DDP). Bio-active substances are hot-printed onto the surface of the flat polymer film as cargo bits. Spatial

distribution of cargo bits forms the precomputed DOE. In our approach, the bioactive substance does not interact with any [organic solvents](#) and is placed 'as is' onto the inert biopolymer, ensuring no changes in the pharmacological effect of the drug," the scientists write.

"The resulted film acts as a transmissive amplitude-only hologram. This cargo packaging system, that creates a clear far-field [diffraction pattern](#) when illuminated by a coherent light source, can find its place in various biomedical problems. One direct applications of payload [holograms](#) is tracking the lifespan of colorless content and measurement of the characteristic release time of active substances under various environmental conditions. The most likely application of our technology is to complement the standard antibiotic testing procedure. Adding a visual channel for tracking the [drug](#) release, which requires only the presence of a coherent light source, will significantly improve the assessment of the effect of the antibiotic and allow to control visually the release time and amount of eluted [cargo](#)."

More information: Arkady S. Abdurashitov et al, Integrated binary hologram to monitor cargo release from a drug-eluting film, *Light: Advanced Manufacturing* (2022). [DOI: 10.37188/lam.2022.030](https://doi.org/10.37188/lam.2022.030)

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