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All optically controlled organic-inorganic hybrid device

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Development of advanced hybrid structures assembled by combination of organic and inorganic materials attract essential scientific and technological interest in order to meet the requirements of 3D display technologies, optical processing and light manipulation. The outstanding properties as large anisotropy and strong birefringence typical for organics and high photosensitivity and charge carrier motilities of in organics open possibilities to optimize their properties independently and combine them into a single device with enhanced functionality. We report a hybrid device, based on excellent photoconductivity of doped Sillenite photorefractive crystals and strong birefringence of polymer dispersed liquid crystal (PDLC) layer Light-induced properties of doped Sillenite crystals have been studied by time-resolved spectroscopy. The photo-excited charge carriers generated in photorefractive substrate create an optically induced space charge field, sufficient to penetrate into the PDLC layer and to re-orient the LC molecules inside the droplets. Beam-coupling measurements at Bragg regime are performed showing prospective amplification values and high spatial resolution. The proposed novel organic-inorganic hybrid structure is simple and easy to fabricate, without requirements for conductive layer deposition (ITO contacts), alignment layers and use of polarizers. Such device allows all the processes to be controlled by light, thus opens further potential for real-time image processing at the near infrared spectral range.

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Microtube arrays create cozy space for neurons to grow fast

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An outstanding challenge for humanity is to continue to understand how our brain works and invent technology to restore neural circuit functionalities. Many neural interfaces used for neuron cell cultures are flat, open, rigid, and opaque, posing challenges to reflect the native microenvironment of the brain and precise engagement with neurons. In this talk, we present a novel neural interface consisting of silicon nitride microtube arrays formed by a new nanotechnology platform that simply relies on strain-induced Self-Rolled-up Membrane (S-RuM) mechanism. These microtubes are transparent, provide three-dimensional adhesion, and most importantly, dramatically accelerate and steadily guide the growth of cortical neuron cells. The ability of the microtube array to control the speed and direction of axonal extension provides a key element in arranging patterned neural networks that have both short and long range connections. Since the micro tube diameter, site, and spacing, as well as 3D stacking, can be controlled precisely, this work has clear implications towards building intelligent synthetic neural circuits.

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