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603f - Direct Print Additive Manufacturing of Optical Fiber Interconnects for Board Level Computing Devices

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Abstract

Integrated photonics technology has many compelling advantages for computing and communications applications, including high speed and extremely wide bandwidth operations. Current systems are typically hybrid assemblies of packaged photonic devices where printed circuit boards often serve to route electrical signals and power, and in some cases, have runs of optical fibers. Development of fully integrated photonic systems would allow for higher transmission rates, lower power requirements, improved signal integrity and timing, less heat generation, and improved security of communication signals. Current technology has not been able to overcome how to densely route optical interconnects through tight spaces without losses due to scattering, how to easily connect optical interconnects to devices and finally how to do this in cost effective packages. Here we show that by using a new direct print additive manufacturing (DPAM) process of fused deposition modeling (FDM) of plastic and micro-dispensing of pastes and inks, along with picosecond laser processing, we can 3D print single and multi-mode optical fibers in a controlled manner such that compact, 3-dimensional optical interconnects can be printed along non-lineal paths. We have produced working optical interconnects with fibers core diameters from 77 microns to as small as 12 microns. Our results demonstrate surface roughness in 3D printed 77 micron-diameter optical fibers of less than 450 nm, with optical transmission rates above 46% for proof of concept devices. We anticipate our proof of concept devices to be a starting point in the development of more sophisticated electro-optical computing devices using this new DPAM technique.

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