

Guiding, focusing, and sensing on the sub-wavelength scale using metallic wire arrays

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We show that two-dimensional arrays of thin metallic wires can guide transverse electromagnetic (TEM) waves and focus them to the spatial dimensions much smaller than the vacuum wavelength. This guiding property is retained for the tapered wire bundles which can be used as multi-channel TEM endoscopes: they capture a detailed electromagnetic field profile created by deeply sub-wavelength features of the studied sample and magnify it for observation. The resulting imaging method is superior to the conventional scanning microscopy because of the parallel nature of the image acquisition by multiple metal wires. Possible applications include terahertz and mid-infrared endoscopy with nanoscale resolution.