

# Novel Complex Media For Microwave Applications

Since the 1970s, ESL has been known for its unique frequency selective surface (FSS) research under the direction of Professor Ben Munk. Recent books by Professor Munk describe this pioneering research that has been used widely for antenna and radar cross section design, and more recently for wide-band antenna development.

Much of the FSS work focused on metallization strategies, whereas efforts are now directed on designs that exploit new material combinations and arrangements. Such materials are often known in the literature as left handed or negative media, photonic crystals, and more generally as metamaterials.

## RF Metamaterials

Metamaterial research includes designing, analyzing, and understanding their electrical properties for application to miniature and multifunctional antennas, isolators, phase shifters, RFICs, and sensors. Recent simulations demonstrate that antennas in magnetic photonic crystals (MPCs) can deliver higher gain with a size reduction of more than five times. The MPCs enable this gain due to their unique property of near perfect matching.

Powerful simulation and optimization tools under development are promising the advent of an even greater variety of novel materials to enable new devices and significantly improve performance. This work is being carried out under a Multidisciplinary University Research Initiative (MURI) funded by the Air Force Office of Scientific Research. The MPCs were first introduced by a group at the University of California at Irvine that is also participating in the MURI effort.

