A Waveguide Switch Using Microwave Photonic Bandgap Substrates

*Won-Ho Kim[1], B. Park[1], M. Kim[1], J. Ryu[2], Y. Kim[2]

[1]Korea University, EE Department, Seoul, 136-701 Korea, korea98@korea.ac.kr
[2]Seoul National University, School of Mechanical and Aerospace Engineering, Seoul, 151-742 Korea

Waveguide components offer a solution for convenient system integration in millimeter-wave frequencies. For example, a waveguide duplexer providing a high isolation between the transmit and receive channels could be attached directly to a horn antenna without requiring waveguide-to-microstrip transitions. Previously, Xin *et. al.* demonstrated a 35GHz band-rejection waveguide filter using photonic bandgap (PBG) substrates as the covers for the top and bottom surfaces of a standard rectangular waveguide. As shown in Figure 1, these PBG covers consist of the outside metal ground plane and metal strips, facing toward the inside of the waveguide and lined up orthogonal to the direction of propagation. The conducting vias connect two sides that are separated by a thin dielectric substrate. The gap size between the metal strips determines the PBG resonant frequency at which the large surface impedance prevents TE_{10} mode from propagating in the waveguide. A simple modification on the PBG cover design can improve the filter performance. HFSS simulations indicate that by varying the gap size between strips, thus changing the resonant frequency at different locations of the PBG cover, we can substantially increase the filter rejection bandwidth. The waveguide filter could be transformed into a switch by adding switching devices, such as RF MEMS switches or diodes, between the PBG strips. Because the PBG covers are conveniently located on the outside of the waveguide, dc-bias lines for the switching devices can be implemented without difficulty. Efforts are currently being made to fabricate MEMS-switchable PBG substrates at 40GHz.

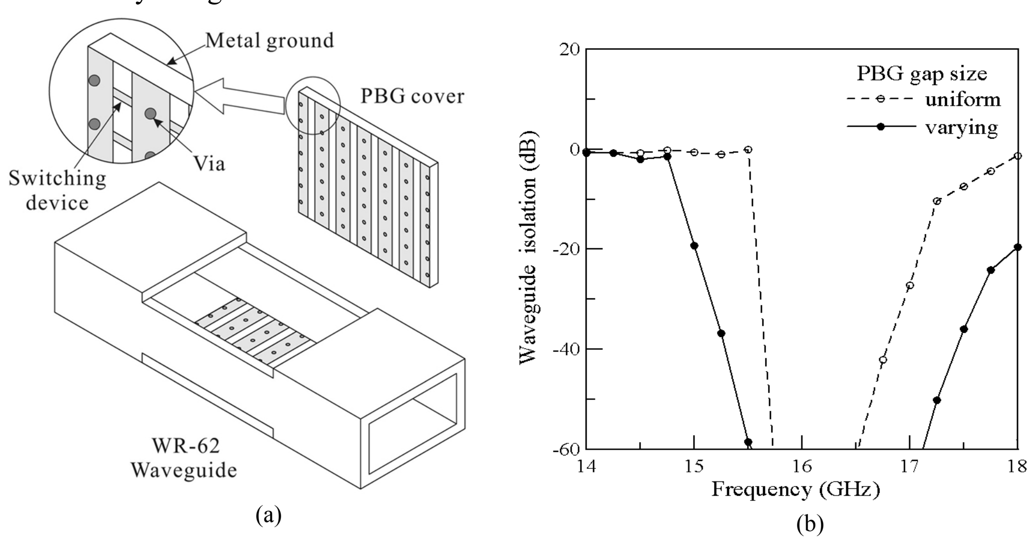

Figure 1. (a) Drawing of a waveguide switch, and (b) HFSS simulation results showing an increase in filter bandwidth when non-uniform gap sizes were used on the 23.7 mm-long PBG cover. Uniform gap size PBG cover was designed to produce an open surface impedance only at 16GHz while the varying gap size cover has three equally-divided sections to achieve an open impedance at 15, 16, and 17 GHz, respectively.