Index matching of TE and TM modes in organic multilayer waveguides

JONATHAN THOMPSON, University of Cincinnati, HEIDRUN SCHMITZER, Xavier University, Cincinnati, HANS PETER WAGNER, University of Cincinnati — We investigate transverse electric (TE) and magnetic (TM) mode propagation in organic multilayers consisting of aluminum quinoline (Alq$_3$) and perylenetetracarboxylic dianhydride (PTCDA). In particular, we analyze two multilayer waveguides, Alq$_3$-PTCDA-Alq$_3$ and PTCDA-Alq$_3$-PTCDA, engineered to give index matching according to modeling. The waveguides were grown on a glass substrate via organic molecular beam deposition. Fabry-Perot oscillations observed from reflection measurements were used to confirm the individual layer thicknesses. We were able to observe refractive index matching between TE$_0$ and TE$_1$, as well as TE$_2$ and TE$_3$ modes for the PTCDA-Alq$_3$-PTCDA waveguide due to the light propagation through the top and bottom PTCDA layers, respectively. In addition, we were able to match TE$_1$ and TM$_1$, as well as TE$_3$ and TM$_3$ modes in the Alq$_3$-PTCDA-Alq$_3$ multilayer due to the birefringence of the PTCDA layer. Furthermore, we are able to create mode matching for a range of wavelengths due to the similar effective refractive index dispersion of different waveguide modes. The ability to phase match different waveguide modes opens a wide range of potential applications including polarization-insensitive propagation and mode switching by adding a thin magnetic metal film within the waveguide and applying an external magnetic field.