

Metasurfaces are the 2D version of metamaterials technology and are designed as planar periodic structures with a unit cell size of less than  $0.1\lambda$ . The metamaterials can be characterized by the homogenization method by effective tensor electric ( $3 \times 3$  matrix) and magnetic ( $3 \times 3$  matrix) susceptibilities. In the case of metasurfaces with printed elements and arbitrary geometry (our case study), the metasurface can be represented by a shunt tensor surface impedance.

The representation of the metasurface by the model of a shunt tensor surface impedance is based on the assumption that there are no magnetic polarization currents tangential to the metasurface, and no electric polarization currents perpendicular to the metasurface. This assumption is inaccurate for large incident angles (larger than 30-40 degrees) and multilayer structures. Therefore, an improved model has been developed for larger incident angles which gives better results.

The modeling of the metasurface as a surface impedance simplifies the entire design cycle of a multilayer metasurface structure using transmission line theory.

A 3D-flat lens based on metasurface technology with printed elements is designed using the new model for validation purpose.