Instructions for design of metalens with Moxtek's design library:

1. Download the zip folder from Moxtek. Copy the meta-atom library files to your Zemax project folder.
2. In Zemax OpticStudio, add a surface to represent the metalens. The surface can be either of type “Binary 2”, or “User defined” with the dll file set as "us\_binary\_mix12\_231020.dll". The Binary 2 element can only create radially symmetric lenses, but the user defined surface can create non-symmetric lenses that incorporate cartesian terms (X^n×Y^m). For either surface, optimize the coefficients to fit your needs.
   1. For the “Binary 2” surface, leave the radius terms at zero and adjust only the terms starting with “Maximum Term #”. Leave “Diffract order” equal to 1.
   2. For the “User defined” surface, leave the parameters "Par Pow Mode" and "Custom Pow" equal to zero because they are not relevant for optimizing the phase profile of the metalens.
   3. The metalens surface should be on a flat piece of glass. The material should be set to “EAGLEXG”. This material can be added to your material catalog by copying ‘MOXTEK.AGF’ from the zip folder to your Zemax/GlassCat folder.
3. Copy the coefficients of the surface element to a csv file, with the value on the second line.
   1. For the “Binary 2” surface, the first value is “Max Term #”. See the template “Example -Binary 2.csv” included in the zip folder.
   2. For the “User defined” surface, the first coefficient is Rnorm. Make sure that “Diffraction Order” is equal to 1. See the template “Example -Binary mix1-2.csv” included in the zip folder.
4. In Lumerical, open the script "Generate\_metalens\_with\_Moxtek\_PDK\_v02.lsf".
   1. Comment/uncomment the value of surface\_type according to the type of surface selected earlier, either “Binary 2” or “"Binary Mix1-2".
   2. Update the metalens\_coefficient\_table variable to the name of the csv file with your lens coefficients.
   3. Update the lens\_diameter\_mm to the desired diameter of the lens in millimeters.
   4. Comment/uncomment propagation\_direction (select air-to-substrate if the light rays propagate from air through the metalens and into the substrate; select substrate-to-air if they proceed in the reverse direction).
   5. Select the target wavelength from the available options by setting the value of target\_wavelength. Currently, only 455nm, 532nm, 633nm are available.
   6. Decide whether to use Moxtek’s proprietary geometry. This setting can produce metalenses that have greater efficiency, but is limited to phase profiles that are rotationally symmetric. If you want to use Moxtek’s proprietary geometry, set the value of use\_Moxtek\_proprietary\_geometry to true.
   7. Run the script. This will generate a metalens file in .h5 format.
5. Copy the generated .h5 metalens file to your Zemax surfaces folder (typically located at C:\Users\username\Documents\Zemax\DLL\Surfaces\).
6. In Zemax OpticStudio, select your metalens surface and set the surface type to “user defined” and select "lumerical-metalens-2025R2.dll" as the data file.
   1. Change the comment to the name of the metalens file you copied in the last step (including the '.h5' extension). Make sure that "Make Log" is set to 99, "Method" to 1, and "Order" to 0. Window size may need to adjusted manually to get expected results. A good starting point is to use:

For more information on these parameters, please see the tutorial here: <https://optics.ansys.com/hc/en-us/articles/18254409091987-Large-Scale-Metalens-Ray-Propagation>.

* 1. Reload all surfaces.

1. A simulation of a Moxtek metalens with your specifications should now be working in your optical system.