Tutorial for Calculation of 1D Metamaterial

with compressed instructions

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ComPhysics

Symbols and abbreviations used in E2M

Symbol	Meaning
L#	Layer index
T.	Thickness
λ	Wavelength
μ′	Real part of relative permeability
μ″	Imaginary part of relative permeability
ε′	Real part of relative permittivity
ε″	Imaginary part of relative permittivity
$\tilde{k}$	Normalized wave vector
GX#	G: Group index X: seperator meaning times #: Repetition num. for the group
θ	The azimuthal angle
φ	The polar angle
TE	Transverse Electric
TM	Transverse Magnetic
R	Reflectance
T	Transmittance
A	Absorptance (R + T + A = 1)
α	Thickness of a period
c	speed of light

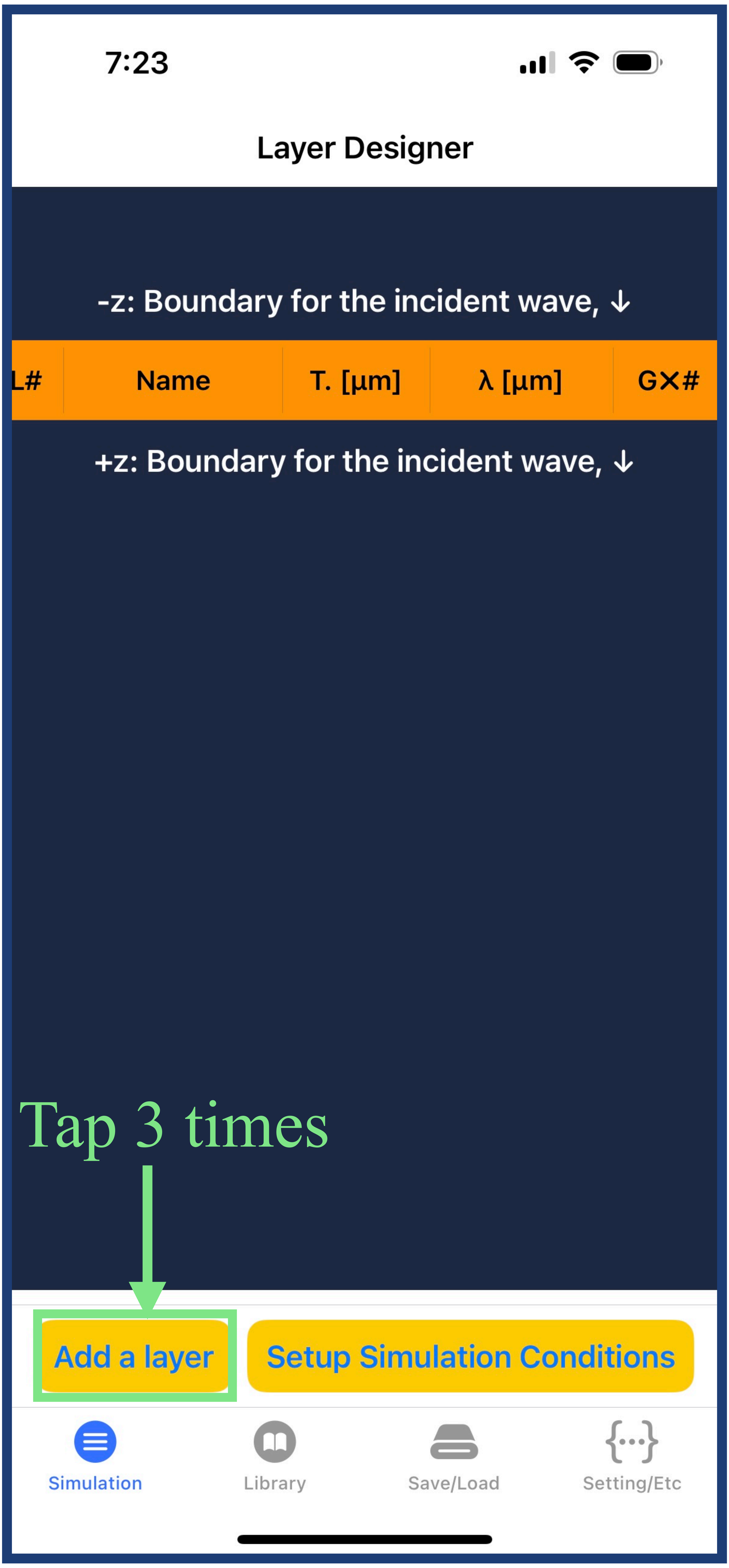
In this tutorial, step-by-step instructions for recalculating the bottom panel of Fig. 3 in Reference 1 are offered. By performing these steps, the capability of simulation of 1D metamaterial will be shown.

This tutorial does not require a paid subscription to complete but assumes that you read the M01 and M02 documents.

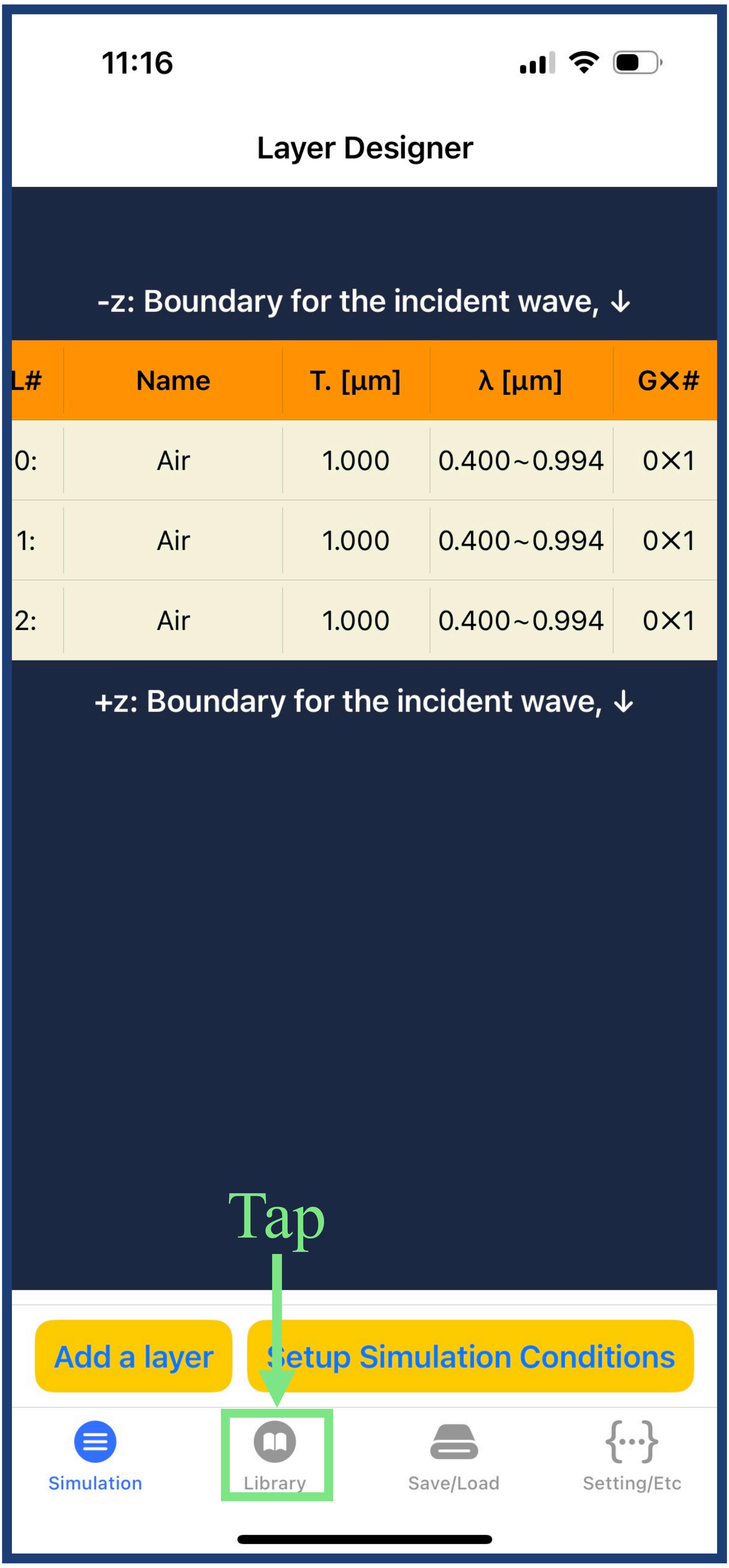
On the next page, this tutorial will finally start.

1) Gerardin, J. and A. Lakhtakia, “Negative index of refraction and distributed Bragg reflectors,” Mic. and Opt. Tech. Lett., Vol. 34,No. 6, 409–411, 2002.

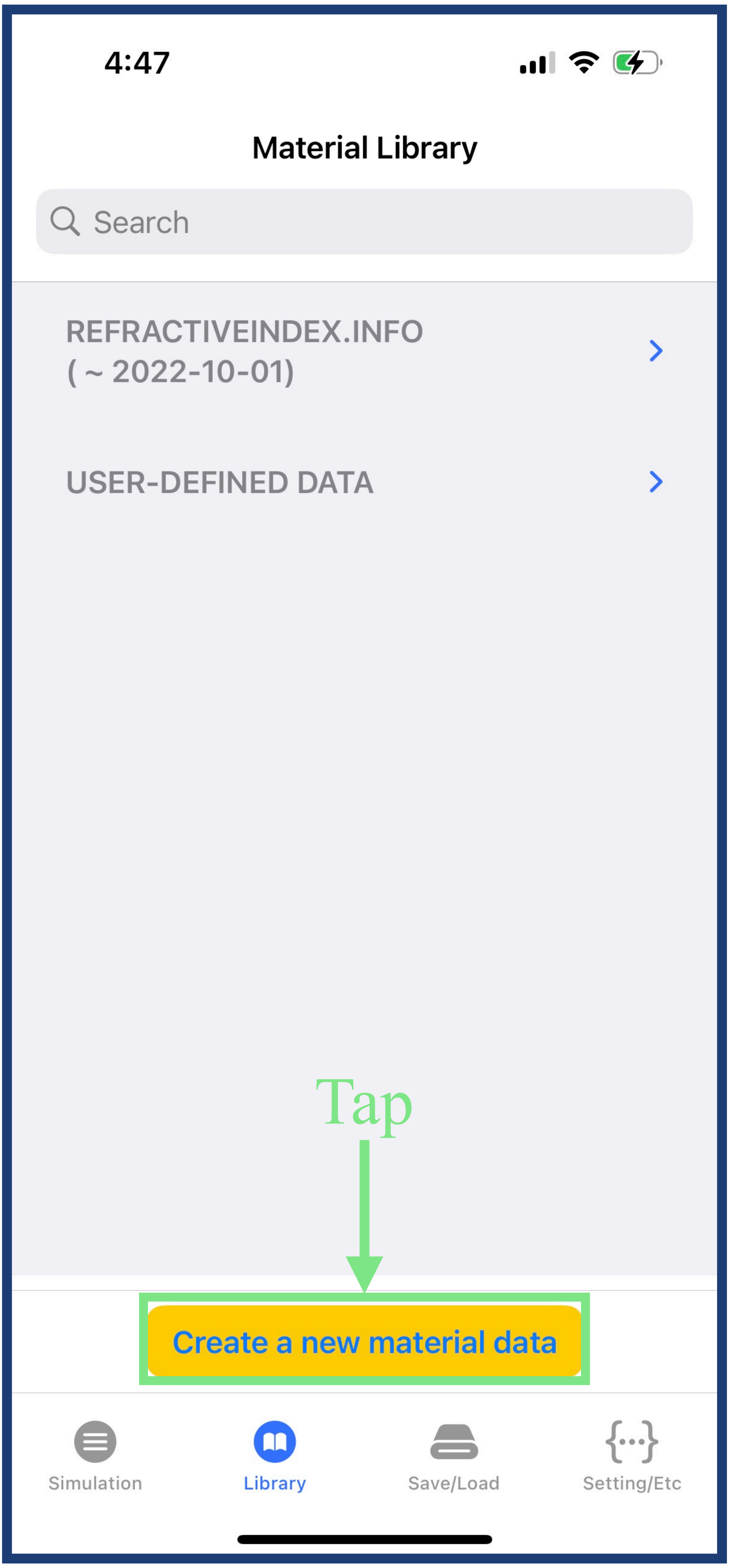
1. Tap "Add a layer" button three times to create three layers. Boundary must maintain "-z: Boundary for the incident wave, ↓" and "+z: Boundary for the incident wave, ↓".



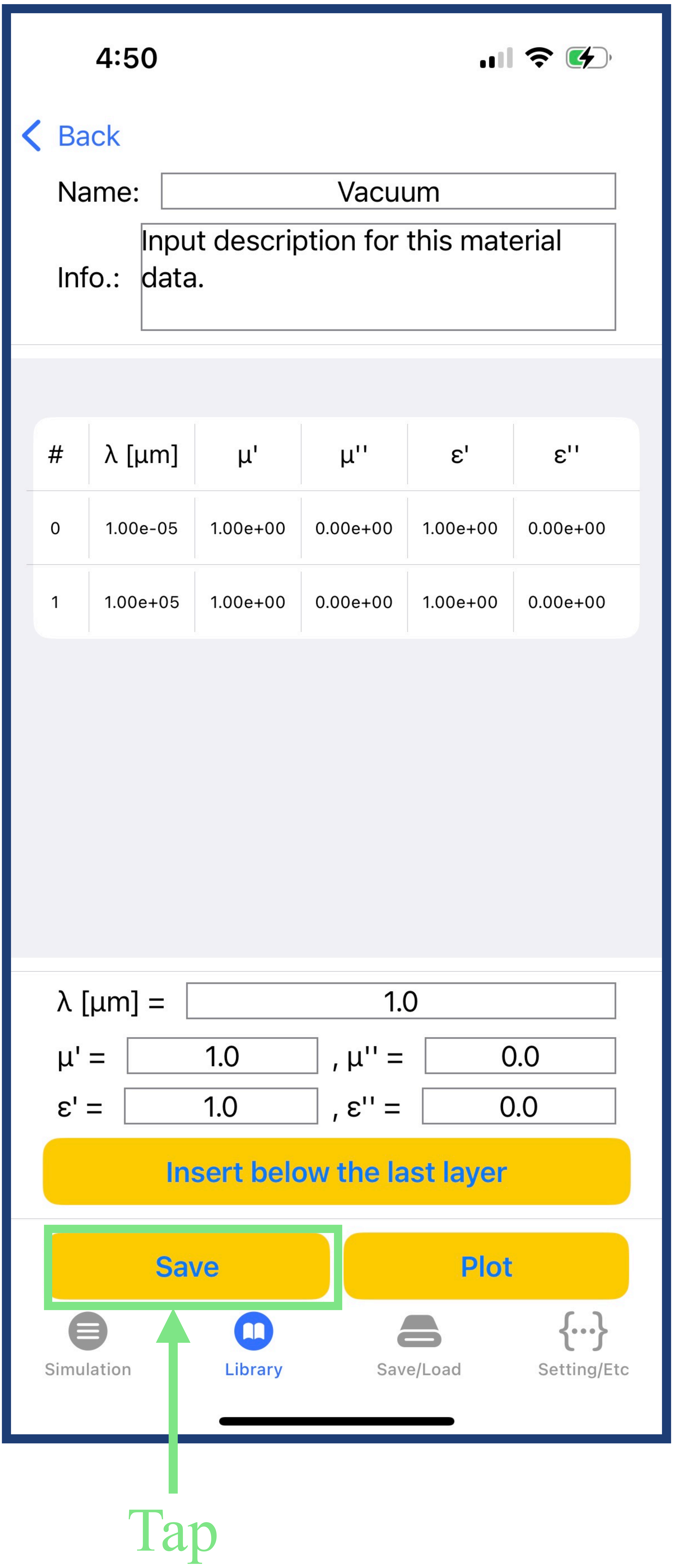
2. We need to create two new user-defined materials before inputting each layer's information. Tap the "Library" icon.



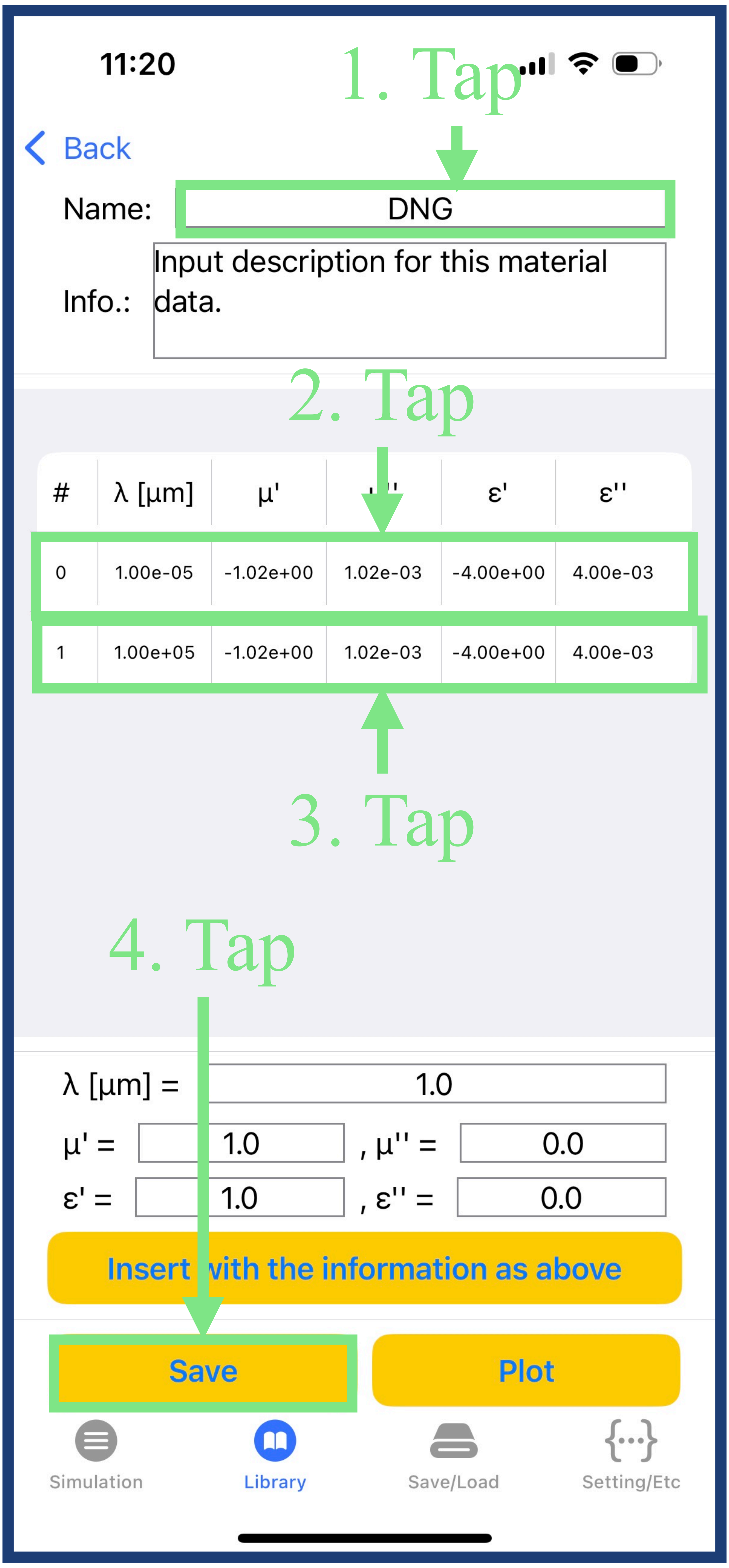
3. Tap “Create a new material data” button.



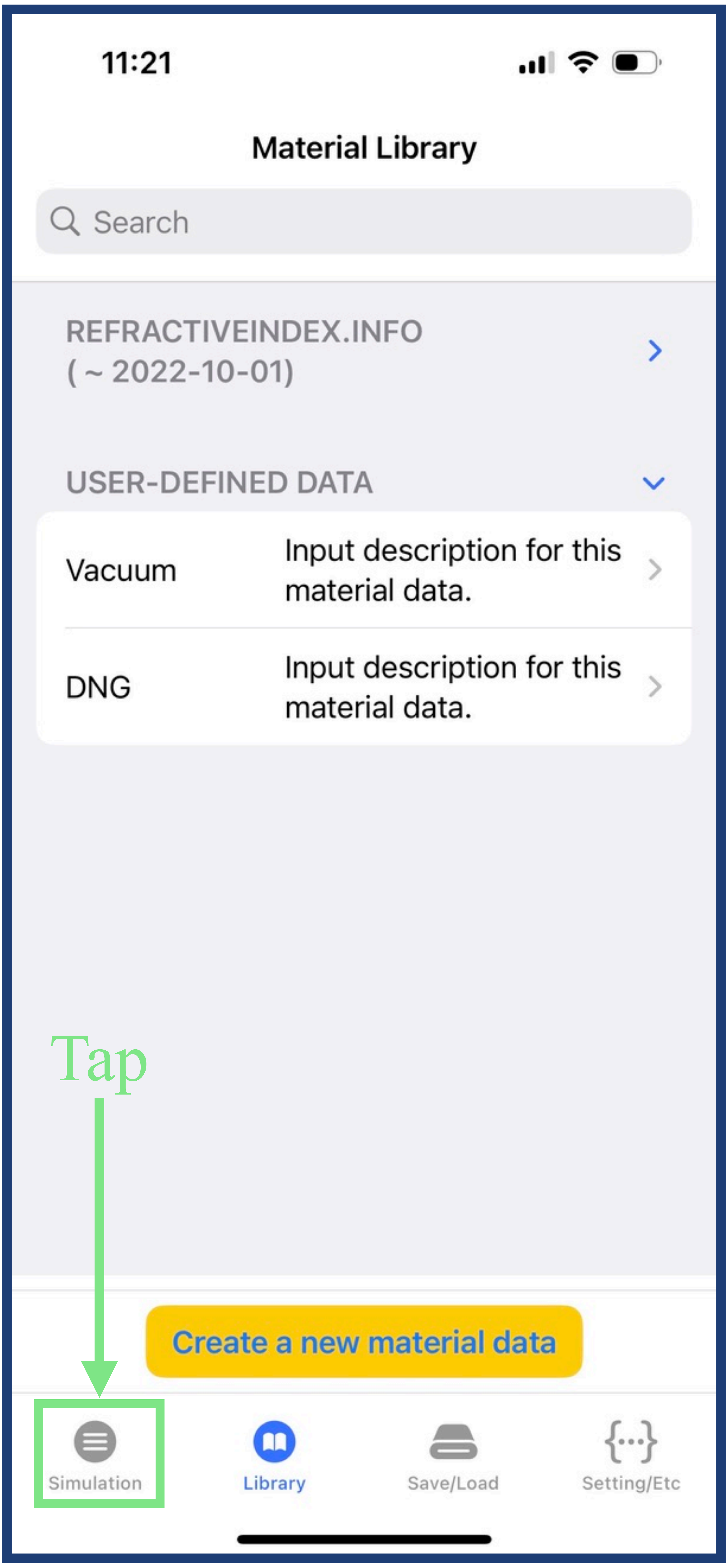
4. The first required material is Vacuum. Thus, let us just tap the “Save” button.



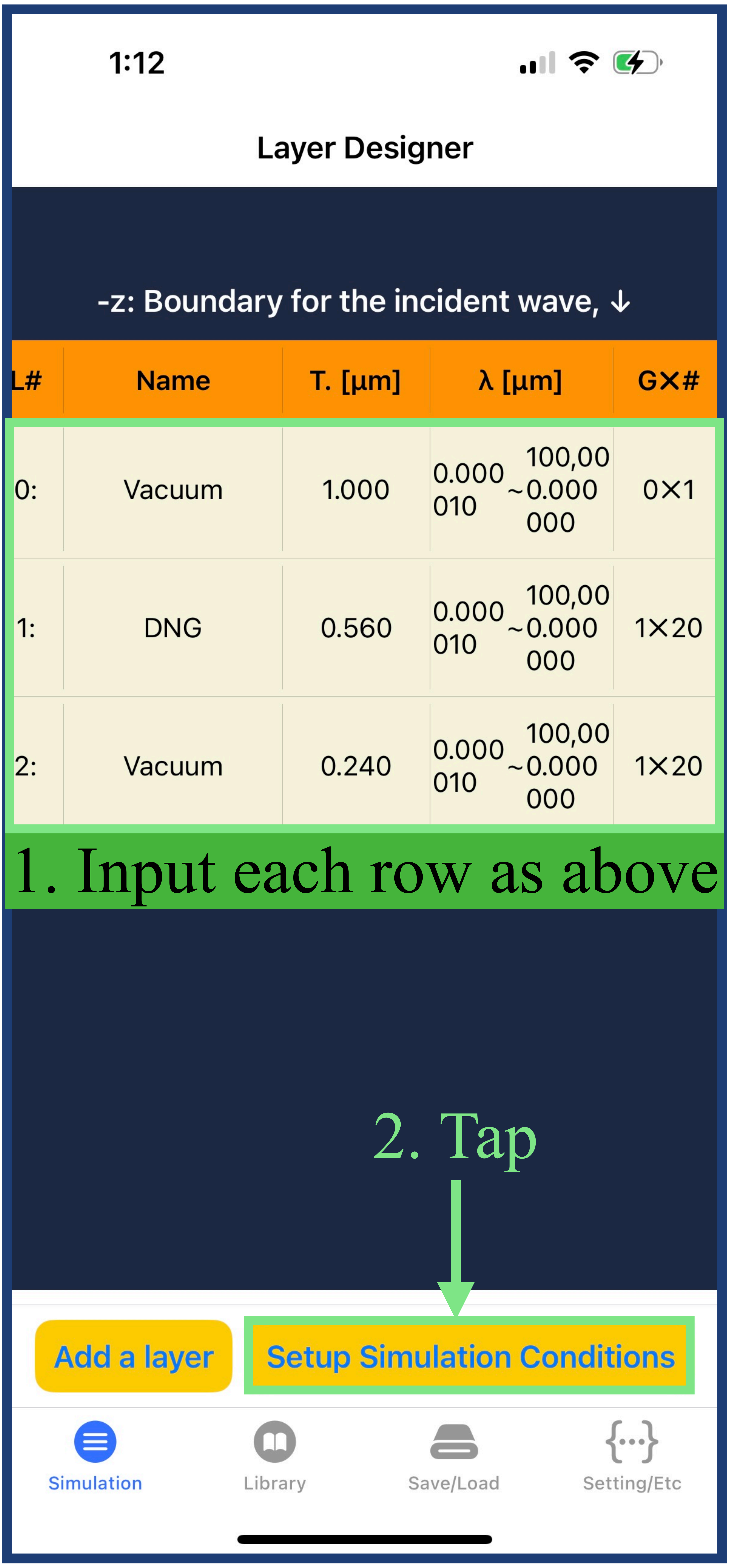
5. Next required material is DNG (Double Negative). Tap the name field and enter “DNG”. Then, tap row #0 in the table and input the values -1.02, 0.00102, -4.0, and 0.004 for μ', μ'', ε', and ε'', respectively. Next, tap #1 row of the table and input the same values into the same fields. Then tap the “Save” button.



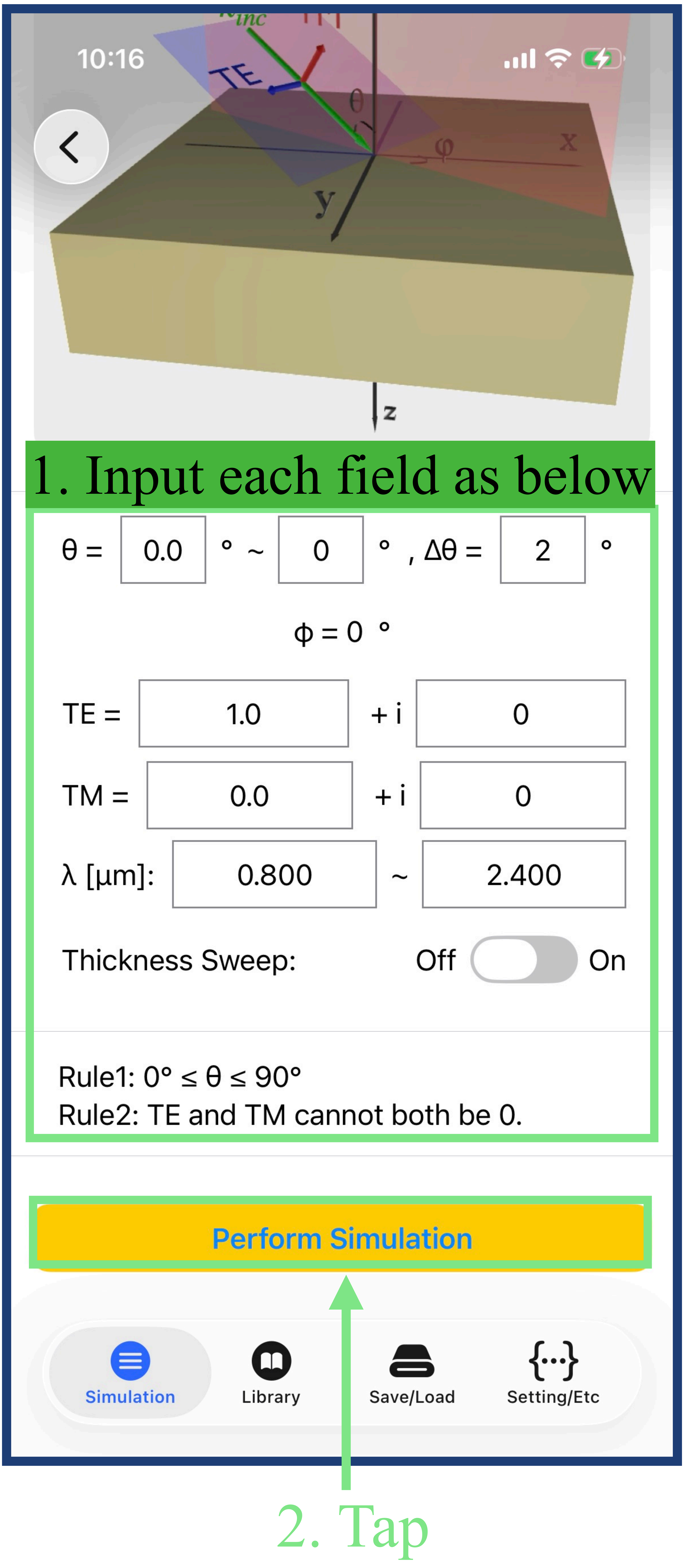
6. You can confirm the two created user-defined materials as below after tapping “USER-DEFINED DATA” section. Next, tap “Simulation” icon.



7. Select material, input thickness, and group-related parameters as shown below for each layer. After that, tap the "Setup Simulation Conditions" button.



8. Complete all fields as drawn below, and then tap the “Perform Simulation” button.



9. Compare the extracted λ spectrum with the result from the reference.