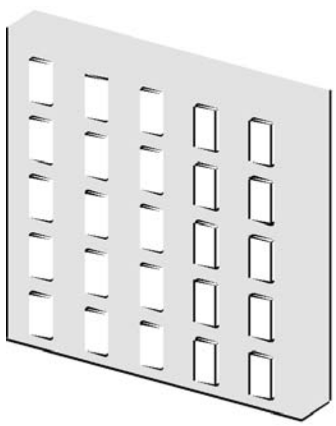
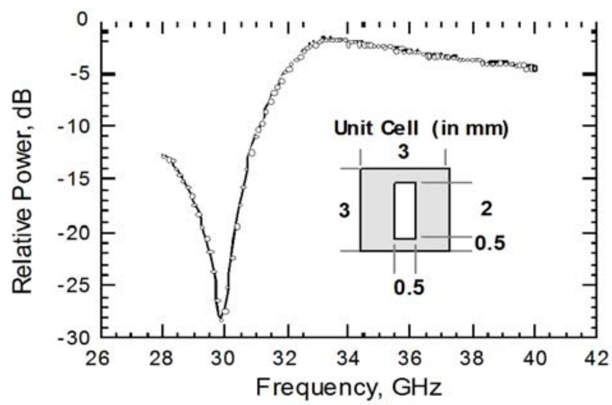
Homework #4 - Part 1 **Due: Friday, 16 February 2001**

As discussed in class, scattering from large periodic surfaces can be modelled by a unit cell loading an equivalent waveguide, where the waveguide walls are chosen to image an infinite array. One simple approach that is related to the variational method involves computed the equivalent circuit for the unit cell using the so-called *induced EMF method*,

$$Z_{eq} = -\frac{1}{|I_0|^2} \iint \overline{E} \cdot \overline{J}_s \, dS$$

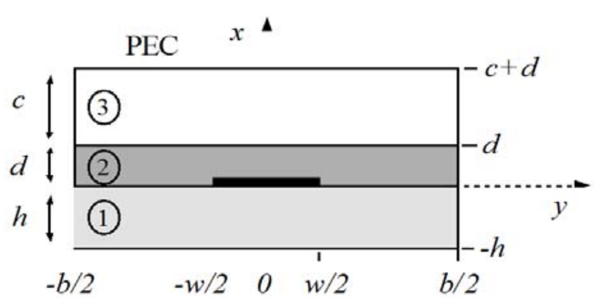
where J_s is the current flowing on the grid metallization, and $\overline{E}$ is the field produced by the current. This expression can be derived from power conservation or reciprocity (reaction conservation), an is useful provided one can guess the current distribution accurately. The current and fields are represented by modal expansions, and the field expansion coefficients are determined by enforcing the boundary conditions as usual. **Compute the equivalent circuit and resulting power transmission for the short dipole grid shown below, assuming a normally incident and vertically polarized beam (E-field parallel to the dipoles).** Gaussian-beam measurements (performed at UCSB) for a given unit cell dimension are shown for comparison with theory over Ka-band (26-40 GHz). The grid was fabricated on 15 mil Duroid with $\epsilon_r = 10.1 \pm 5\%$.





Part 2 — Due: Wednesday, 21 February 2001

Modify the Mathematica script "Microstrip.nb" (available on the course web site) to compute the dispersion characteristics of microstrip with a dielectric coating, as shown below:



Do not attempt to compute characteristic impedance!!!! Make a plot of ϵ_{eff} versus frequency for the case of microstrip on sapphire ($\epsilon_{r1} = 9.8$, h=500 μm), with a thin coating of Barium Strontium Titanate ($\epsilon_{r2} = 200$, d=100 nm). Assume w/h=1 and region-3 is air with $c = 10h$ for this calculation.