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The Use of a Capacitor Tunnel Diode Resonating Circuit to Measure Material Properties OWEN HUFF, NICHOLAS BRESLIN, ALEXANDER BLANTON, RYAN GORDON, Western Illinois University — A tunnel diode resonator (or TDR) is a specialized circuit that is a tunneling diode connected to a capacitor-inductor oscillator. Applying the proper amount of DC voltage to the diode results in an alternating current that sustains the oscillations in the tank oscillator. The resonant frequency can then be shifted by the inclusion of materials in the capacitor of the oscillator through its interaction with the electric field there. One major goal of this experimental technique is to measure the dielectric constant of materials. Due to the use of high precision electronic instrumentation, changes in the resonant frequency can be measured with parts-per-billion precision, thus allowing the determination of the dielectric constant with great precision. Furthermore, by performing these experiments at low temperatures we can filter out sources of error such as thermal motion, and observe changes in materials that occur only at low temperatures. Plans have been made to measure the dielectric constant of $(V_{1-x}Ti_x)O_2$, a crystalline material that undergoes a metal-insulator transition.

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