Microwave Spectroscopy in Skin Cancer Detection and Diagnosis  
(A Preliminary View)  
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INTRODUCTION
Skin cancer types [1]:
•Basal Cell Carcinoma
•Squamous Cell Carcinoma
•Melanoma  The Most Dangerous Type!

NO SIGNIFICANT ADVANCES IN TREATING ADVANCED STAGE MELANOMA HAVE BEEN MADE IN 30 YEARS! [2]

What’s needed: A highly accurate early detection test that will reduce the delay, discomfort and anxiety of a biopsy

HISTORY AND BACKGROUND
Lightwave Spectroscopy [3]: High frequency, good resolution, low penetration depth
Impedance Spectroscopy [4]: Low frequency, good penetration depth, inconclusive results
Microwave Spectroscopy: Frequencies between lightwave and impedance techniques

Interdisciplinary collaboration is essential to the success of this project and is reflected in on-going IGERT collaborations with Dr. Noreen Luetteke of Moffitt Cancer Center, Dr. Susan Hagness (University of Wisconsin-Madison) and Dr. John Whittaker (University of Michigan).

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REFERENCES

METHODOLOGY
•“Proof of Concept” tests at 10 GHz using non-biological dielectric material samples.
•These trials are designed to demonstrate the variations in reflection characteristics of the microwave signal as the material samples, and consequently the material properties, are changed.
•Test setup shown in Figure 1
•Preliminary data shown in Table 1.

FUTURE WORK
•Investigate angiogenic nature of tumorous tissue (Figure 2).
•Focus on increased 65 GHz resonant frequency of oxygenated tissue (Figure 3).
•Conduct tests on biologically-derived sample material
•Compare results obtained from cancerous and non-cancerous samples

TABLE 1  
DIELECTRIC SAMPLE RETURN LOSS COMPARISON

<table>
<thead>
<tr>
<th>Material(s)</th>
<th>Thickness (mm)</th>
<th>$\varepsilon_r$</th>
<th>Tan $\delta$</th>
<th>Analytical</th>
<th>Measured</th>
<th>Agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>RT6006</td>
<td>2.50</td>
<td>6.15</td>
<td>0.0019</td>
<td>8.88 dB</td>
<td>9.88 dB</td>
<td>+1.10 dB</td>
</tr>
<tr>
<td>TMM101</td>
<td>3.18</td>
<td>9.80</td>
<td>0.0020</td>
<td>10.75 dB</td>
<td>9.80 dB</td>
<td>-0.95 dB</td>
</tr>
<tr>
<td>RT6006/RT5880</td>
<td>2.50/3.14</td>
<td>6.15/2.20</td>
<td>0.0019/0.0009</td>
<td>11.93 dB</td>
<td>10.97 dB</td>
<td>-0.96 dB</td>
</tr>
<tr>
<td>TMM101/RT5880</td>
<td>3.18/3.14</td>
<td>6.15/2.20</td>
<td>0.0020/0.0009</td>
<td>11.94 dB</td>
<td>11.21 dB</td>
<td>-0.73 dB</td>
</tr>
</tbody>
</table>

FUTURE WORK

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