### University of Arizona

# Materials Science and Engineering

## MSE 110: Solid State Chemistry

##### Relationship between Bonding Type and Property of Solids

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##### Relationship between Bonding Type and Property of Solids

**Introduction (2.0 Points)**

The purpose of this experiment is to identify two different properties of solid materials. The first being the electrical resistance of the material based on the bond types, and the second being the transparency of the material and their bond types. With the resistance of the materials and their bond types, certain bond types have higher resistance such as ionic bonds which have very high electrical resistance and little conductivity. By measuring the resistance values, we are able to confirm what kinds of bonds the material is. Same concept with regards to the idea of transparency and transmission. If a bond is ionic, then the material is most likely going to be transparent. If it is a metallic bond, then the material is probably opaque. The transparency of a material is also related to the conductivity and electrical resistance. Theoretically, if a material is opaque, it is likely that it will be conductive as it will have a metallic bond and will not let light pass, an indication that it instead reflects the energy instead of absorbing it. This allows for conductivity and little resistance.

###### Experimental Procedure (2.0 Points)

To measure the electrical resistance of the materials.

1. Plug in alligator cables into a multimeter terminal. The black cable goes into the VΩ terminal, and the red cable goes into the COM terminal.
2. Set the multimeter dial to the Ω resistance setting.
3. Connect both alligator clips to the material, being careful not to break the material.
4. Set the alligator clips and the material on the table, observing the resistance level, and letting it find its value before recording it.

To measure the optical transmission of the materials.

1. Open the Spectrometer software provided.
2. Connect the spectrometer to the lamp and the computer.
3. Turn on the lamp and start recording data to calibrate the spectrometer. This is done through the following two steps.
4. Turn the light off to record a dark spectrum.
5. Turn the light back on to record a reference spectrum.
6. Start placing the materials one by one under the lamp and record the transmission spectrums in text form, this will give the data in a table like format.
7. Export the data to Excel and graph the different transmission spectrum graphs for each material.

###### Experimental Results (2.5 Points)

|  |  |  |
| --- | --- | --- |
| **Material** | **Resistance** | **Measured value** |
| Silicone (Si) | 29.2 | M Ω |
| Zinc Selenide (ZnSe) | 40 | M Ω |
| Glass | 40 | M Ω |
| Copper (Cu) | 1 | Ω |

###### Discussion and Conclusions (3.0 Points)

The relationship between resistance and conductivity are indirectly proportional. The higher the resistance, the lower the conductivity. Based on the results recorded, this is clearly shown as a material like glass, has a higher resistance, but almost no conductivity. For bonding types and electrical resistance, ionic bonds have higher electrical resistance, covalent bonds are semiconductors and have medium amounts of electrical resistance, and metallic bonds are conductors and have little to minimal electrical resistance. With the materials tested, we see this reflected as glass is an ionic compound and has extremely high resistance; silicone has a covalent bond, and the resistance is about in the middle; copper is a metallic bond and has low electrical resistance; and zinc selenide while it may appear to be a covalent bond it is in fact an ionic bond and has high electrical resistance as reflected by the data recorded. The bonding types also have an effect on the transparency on the materials, ionic bonds (glass) are clear, covalent bonds (zinc selenide) are translucent, and metallic bonds (copper) are opaque.

There was a lack of data regarding the transmission spectrum graphs for each respective material. This was not due to any fault of faulty data or the machines being unable to accurately capture it, rather we had forgotten to share or export the data to all of our emails. Therefore, there is no data on the graphs to discuss or examine. Overall, the data was fairly easy to obtain with the results being within the general expectations for each material, be it the resistance, or transmission spectrum. If we had the data for the transmission spectrum, we would be able to discuss the cut-off wavelength for silicone and glass, however, as mentioned, that is not possible due to lack of memory and proper reading of the instructions.