Molecular Glasses from the Organic Chemistry Teaching Laboratory to our Daily Life

Lindsay Little, Emily Simmons, Gustavo Salazar*

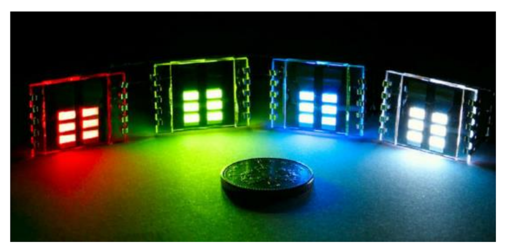
324 Ann Stuart Science Complex P.O. Box 425859 Denton, TX 76204-5859

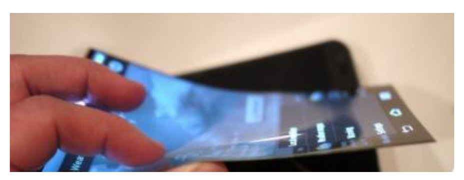
Abstract

Our current quotidian lives are surrounded by a plethora of solid materials built by an enormous chemical repertoire. These collection of materials are made with well-known chemical species such as metals, minerals, polymers, organic materials and ceramics, to name a few. Moreover, novel technologies and techniques have allowed scientists to synthesize and develop more complex materials that include nanostructures, smart gels, and the liquids crystals found in flat screens. However, less attention has been placed on a very interesting category of solids named "Molecular Glasses." Furthermore and despite a hefty effort since the 1960s, these "amorphous" solids have not been in the spotlight as much as their classic counter-part. **This project shows how molecular glasses are hidden in plain sight by presenting the thermophysical properties of chemicals found in our daily life and in the organic chemistry laboratory.**

Molecular Glasses in our Daily Life

OLEDs





Amorphous materials are an integral part of organic light emitting diodes as hosts.

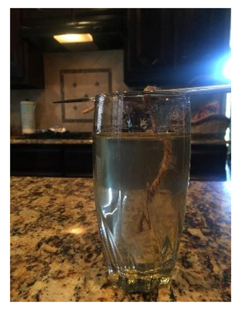
Pharmaceuticals

Amorphous Candy

Organic molecular glasses have desirable solubility and miscibility properties that make them useful for applications in pharmaceutical and food chemistry areas.

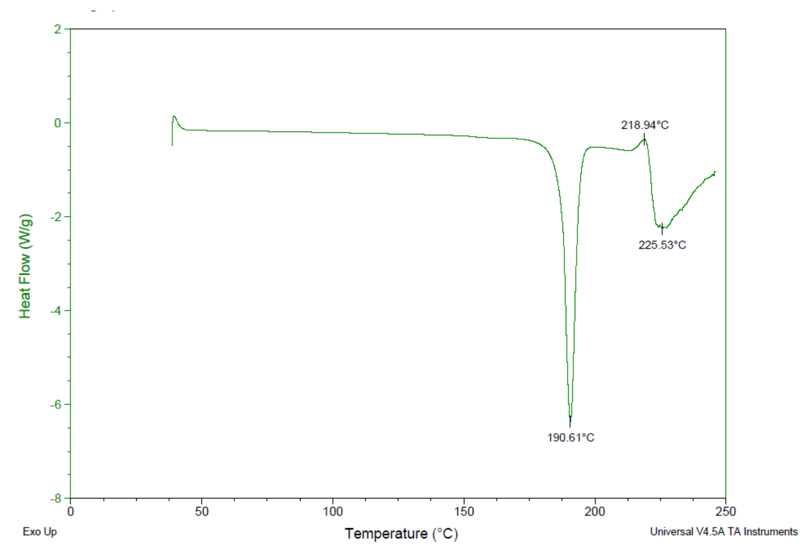
Laboratory Procedures and Results

Crystal (Chemically ordered solid structures)

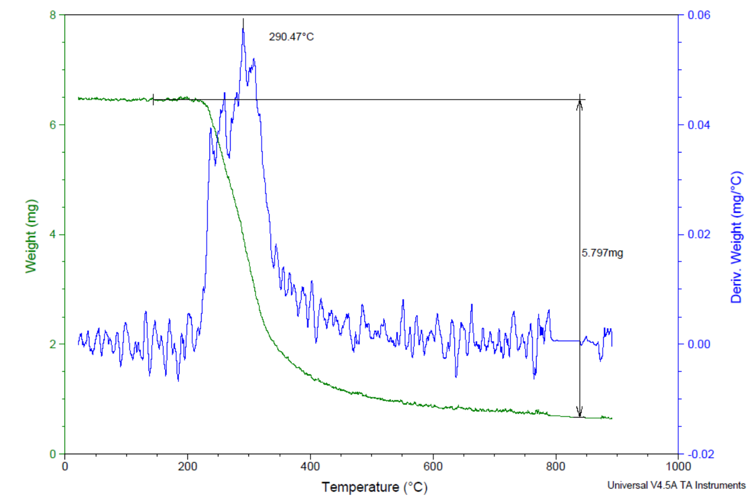


A saturated solution of sugar (sucrose) was boiled under ambient conditions to achieve a homogenous solution. Then, the solution was allowed to cool down with a piece of string hanging in it to start crystallization.

Differential Scanning Calorimetry (DSC) Analyses

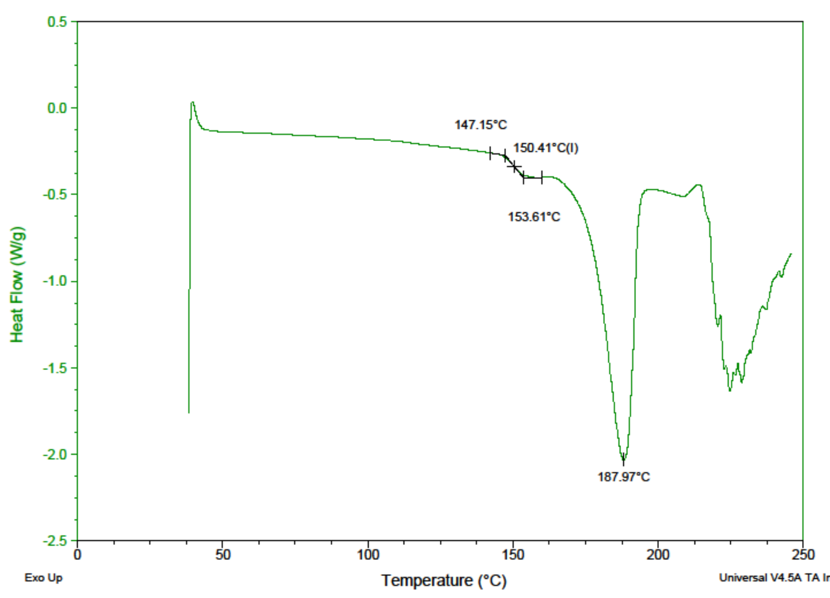


Thermogravimetric Analysis (TGA) of a sugar (sucrose) crystal



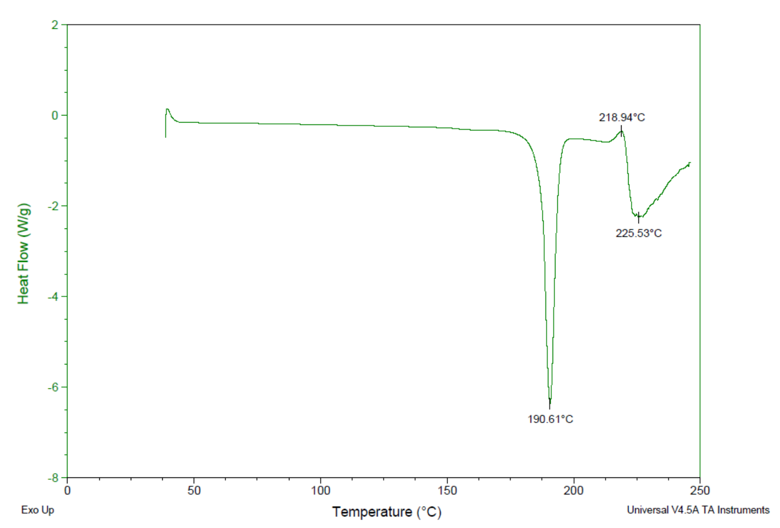
Molecular Glass (Chemically disordered solid structures)

A mixture of sugar with small quantities of light corn syrup and cream of tartar were warmed up until a viscous solid was formed. Then, the sample was allowed to cool down for several days until the amorphous solid formed.



Powder (Collection of many small crystals)

A small sample of dried sugar (sucrose) was ground using glass mortar and pestle until a fine homogenous powder was achieved.



Discussions

- The TGA analysis allows us to set a safe temperature window up to 250° C before any decomposition occurs.
- The DSC result clearly shows the required glass transition temperature, T_g= 150.41° C, for the molecular glass as a "step-down" signal.
- The powder and the single crystal DSC profiles show the sharp signal of the melting point of sucrose at 190° C. Furthermore, no significant T_g signal can be found.

Conclusions

The preparation and thermal analysis of crystalline and amorphous sugar allowed us to present a clear introduction to molecular glasses. Furthermore, the use of the organic chemistry re-crystallization technique permitted us to make a straightforward connection between our experiences with various types of candies and its structural-based chemical composition.