The University of North Dakota has developed an inexpensive, scalable, and cleantech method to manufacture graphene quantum dots (GQDs) that uses amino acids or sugars as basic raw materials. No cadmium or other metals are used. Resulting GQDs have quantum yield of up to 55%, are water soluble, have “tunable” emission wavelengths, and can absorb and emit in both visible and near-infrared (NIR) regions.

Applications
- Displays
- Bioimaging, in vitro and in vivo, using either visible or NIR spectra
- Biosensing in vitro
- Research use, e.g. for enzyme-free catalysis of $\text{H}_2\text{O}_2$ to water
- Electroluminescent and printable fluorescent inks.

Advantages
- Quantum yield up to 55% in visible spectrum
- Tune emission wavelength from individual GQD’s by shifting excitation wavelength
- Emissions in multiple wavelengths, including visible and near infrared (NIR)
- NIR emissions enable detection of GQD fluorescence through body tissue
- Manufacture using glutamic acid, other amino acids, or sugars instead of graphite
- Synthesis is simple, fast, inexpensive, and scalable
- Manufacturing is a single step as compared with multi-step process using graphite
- Environmentally friendly process, no cadmium or other heavy metals
- GQDs are water soluble, can be dried and resuspended without agglomeration

The Technology
The GQD manufacturing is very straightforward and scalable. GQDs are produced by heating glutamic acid or other starting materials (hydrophilic amino acids, sugars, and organic acids) to it’s boiling temperature for about 45 seconds (until color changes from clear to yellow), and then adding water. GQD’s form upon addition of the water, and are ready for use when centrifuged. They can be used wet or dry, and are easily resuspended from powder.