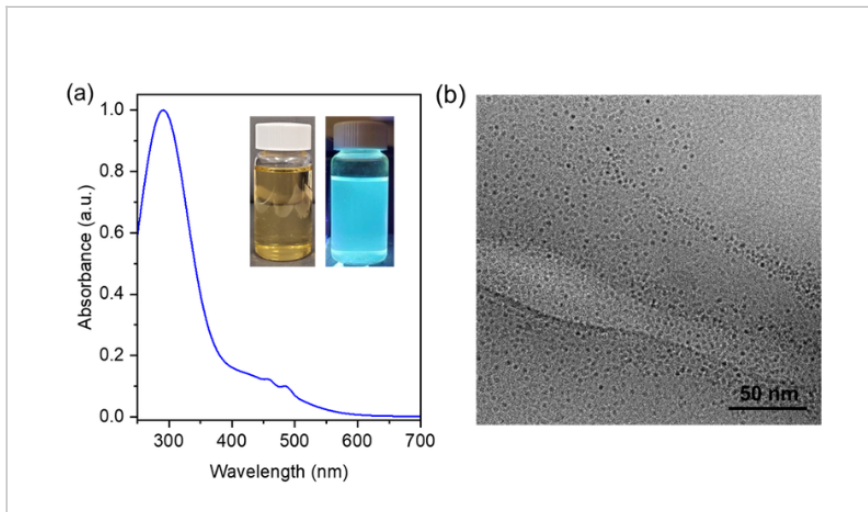


# Solutions of Graphene Quantum Dots Derived from Coal

ID# 2024-5798



PennState



Optical and morphological properties of coal derived GQDs.

## Technology Summary

The inventors developed an efficient intercalation assisted dispersion for solubilizing coal for production, purification of GQDs and formation of advanced composites containing GQDs. In a typical patented process, coal powder is reacted with alkali metal to form an alkali metal-intercalated coal product. The alkali metal-intercalated coal is then dissolved in an organic solvent to form a solution of GQDs. The GQDs are then purified using a mild centrifugation process. This GQD solution is then used to form GQD films, and advanced composites for different applications. After purification, the solution can be concentrated using a precipitation and evaporation process to obtain GQD powder. The GQDs can be redispersed in different low boiling point organic solvents and in water for storage and for further processing in different applications.

## Application & Market Utility

Colloidal semiconductor quantum dots (QDs) are highly promising for use in solar cells, light-emitting diodes, bioimaging, electronic displays, and other optoelectronic devices, due to their unique size-dependent electro-optical properties. Despite their potential, the high market cost of inorganic QDs, > \$1000 per gram, has slowed their industrial adoption. Additionally, their application development has been impeded by their high toxicity. As a cost-effective alternative, graphene quantum dots (GQDs) have recently gained attention as a new class of materials.

## Next Steps

The inventors are looking to license and further develop this solution that can be utilized to deposit GQDs on a given substrate, create GQD films, or manufacture GQD containing composites.

TECHNOLOGY READINESS LEVEL

4

### Seeking

Investment | Licensing |

### Keywords

- Solubilizing Coal
- Graphene Quantum Dots (GQDs)
- Smart Composites

### Researchers

**George Bepete, Ph.D.**

Assistant Research Professor

**Mauricio Terrones, Ph.D.**

Verne M. Willaman Professor of Physics, Professor of Chemistry and Materials Science & Engineering

**Gothamie Ratnayake**

Doctoral Candidate

**David Sanchez**

Doctoral Candidate

**Zhouyang Yu**

Doctoral Candidate

**Andres Fest**

Doctoral Candidate

**Edgar Dimitrov**

Doctoral Candidate

### Other Researchers

#### Originating College

College of Earth and Mineral Sciences

#### Office of Technology Management Contact

Matthew Smith

mds126@psu.edu



Invent Penn State is a Commonwealth-wide initiative to spur economic development, job creation, and student career success. Invent Penn State blends entrepreneurship-focused academic programs, business startup training and incubation, funding for commercialization, and university-community collaborations to facilitate the challenging process of turning research discoveries into valuable products and services that can benefit Pennsylvanians and humankind. Learn more at [invent.psu.edu](http://invent.psu.edu).

Penn State is an equal opportunity, affirmative action employer, and is committed to providing employment opportunities to all qualified applicants without regard to race, color, religion, age, sex, sexual orientation, gender identity, national origin, disability or protected veteran status.