

Modelling of laser-induced white emission of graphene

Wieslaw Strek

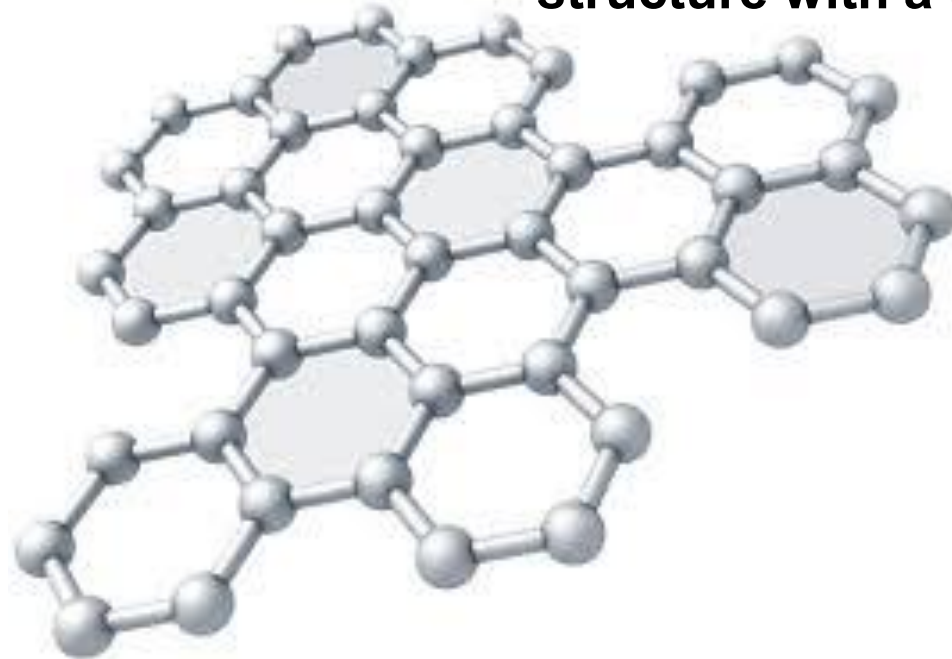
R. Tomala, P. Wiewiorski, M. Stefanski, M. Samsel-Czekala

**Institute of Low Temperature and Structure Research,
Polish Academy of Sciences, 50-422 Wrocław, Poland**

What is graphene?

Graphene

is an allotropic form of carbon which is characterized by a hexagonal structure with a thickness of one atom



- C atoms with sp^2 hybridization
- two-dimensional structure
- one of the strongest bonds in nature

History of discovery



Hanns P. Boehm
(Germany)

1962 – single-layer structure of graphene confirmed by electron microscopy and X-ray measurements

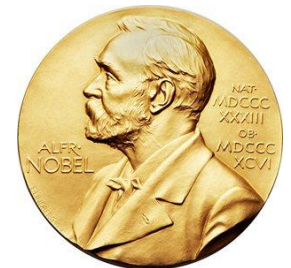


**Andre
Geim**

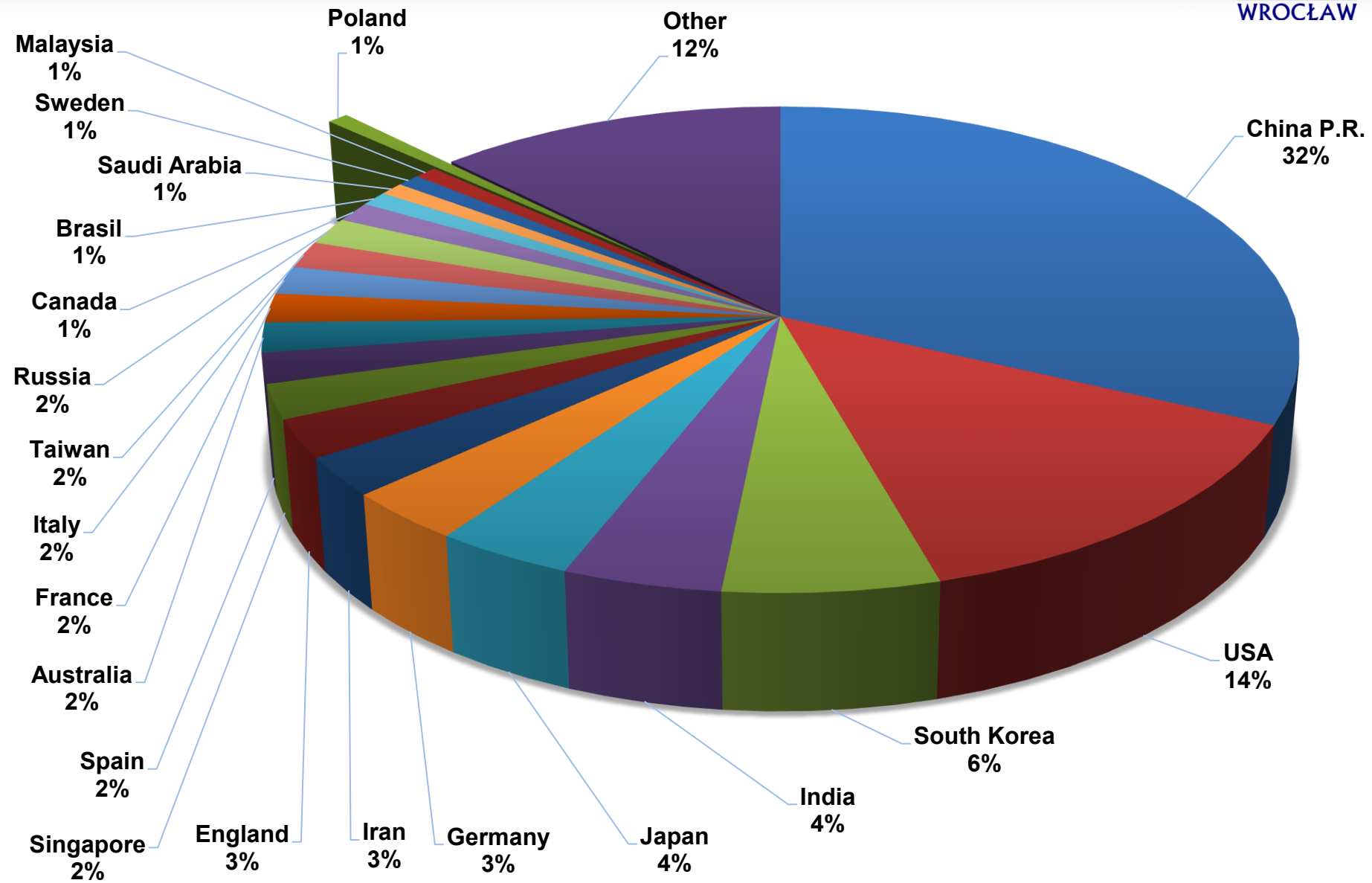


**Konstantin
Novoselov**
(Russia)

2004 – mechanical dissection of graphite to graphene (Nobel Prize in 2010)



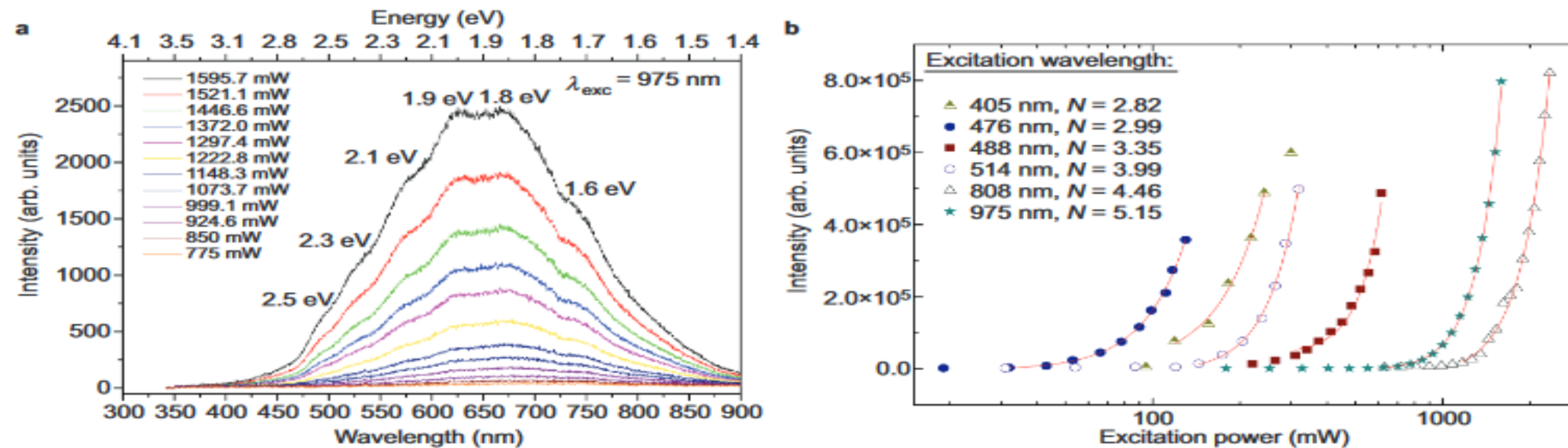
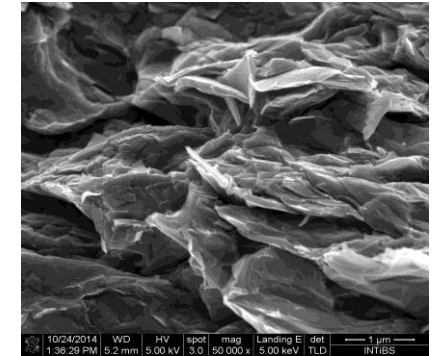
Importance of graphene



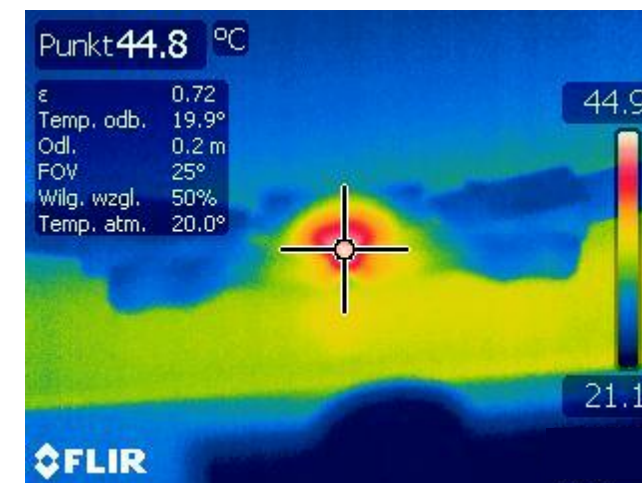
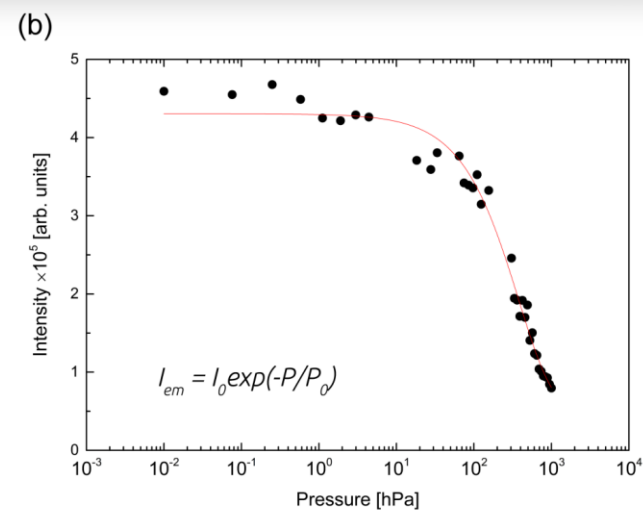
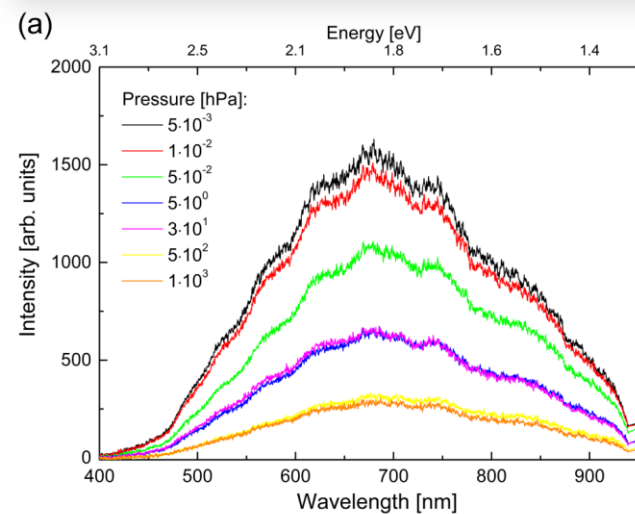
ORIGINAL ARTICLE

Laser-induced white-light emission from graphene ceramics—opening a band gap in graphene

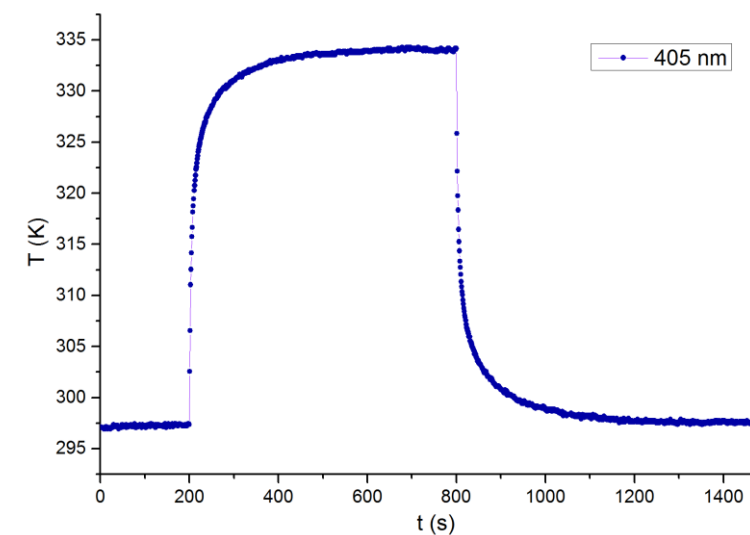
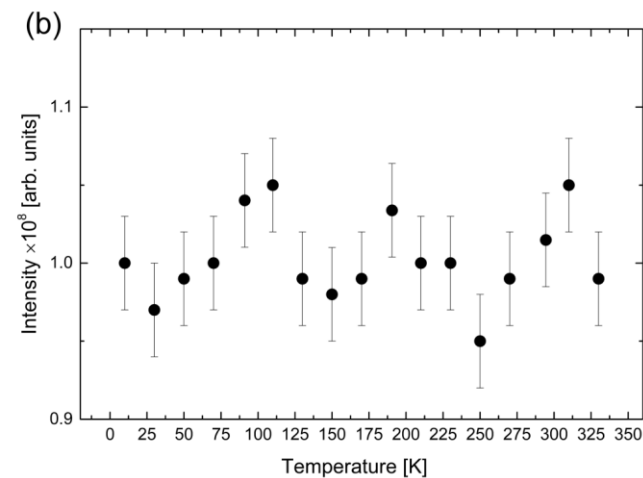
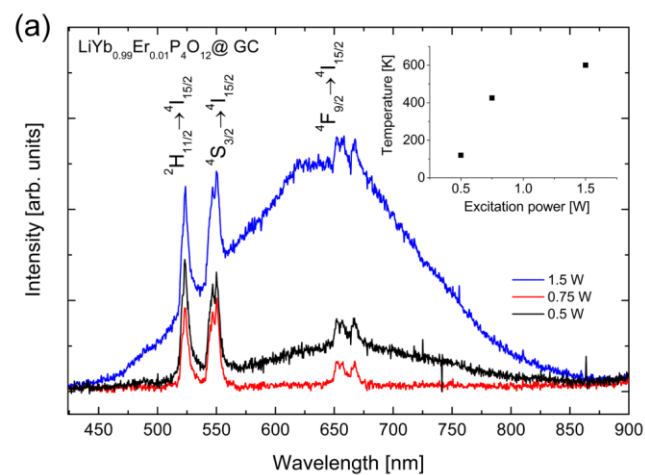
Wiesław Strek¹, Bartłomiej Cichy¹, Lukasz Radosinski², Paweł Gluchowski¹, Lukasz Marciniak¹,
Mikołaj Łukaszewicz¹ and Dariusz Hreniak¹



Previous results

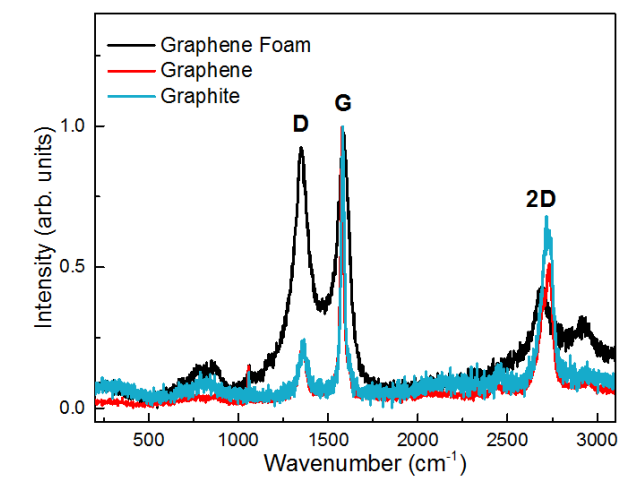
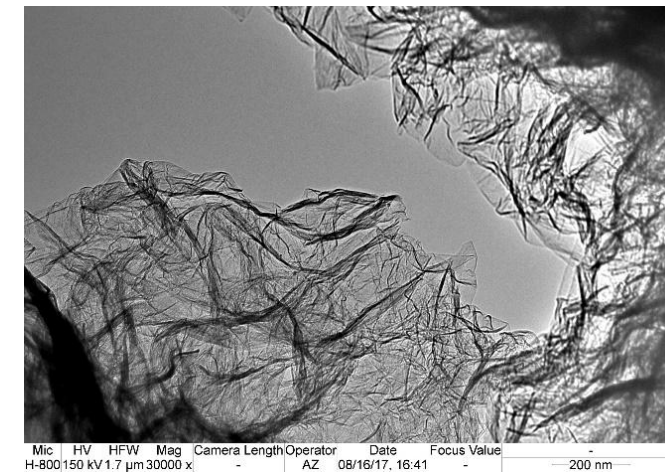
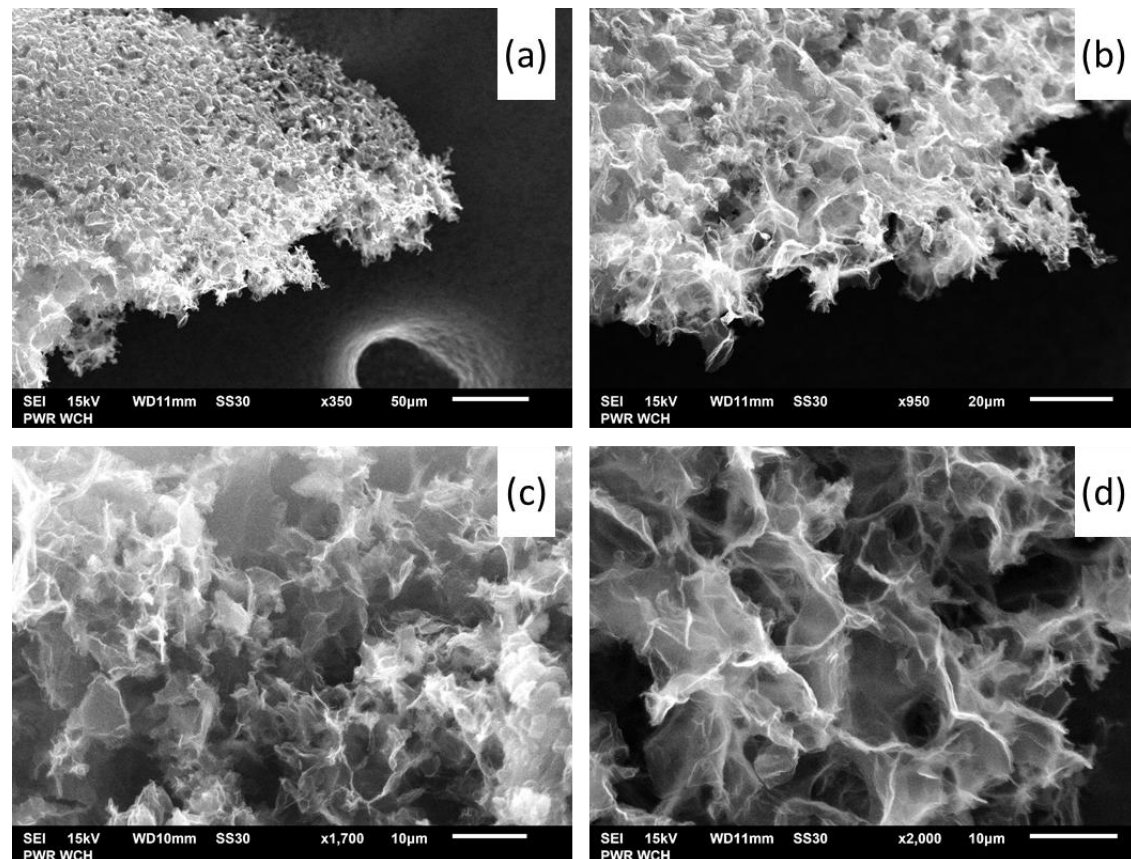


Estimation of effective temperature of emitting sample



Graphene foam

Structure and Morphology of Graphene Foam



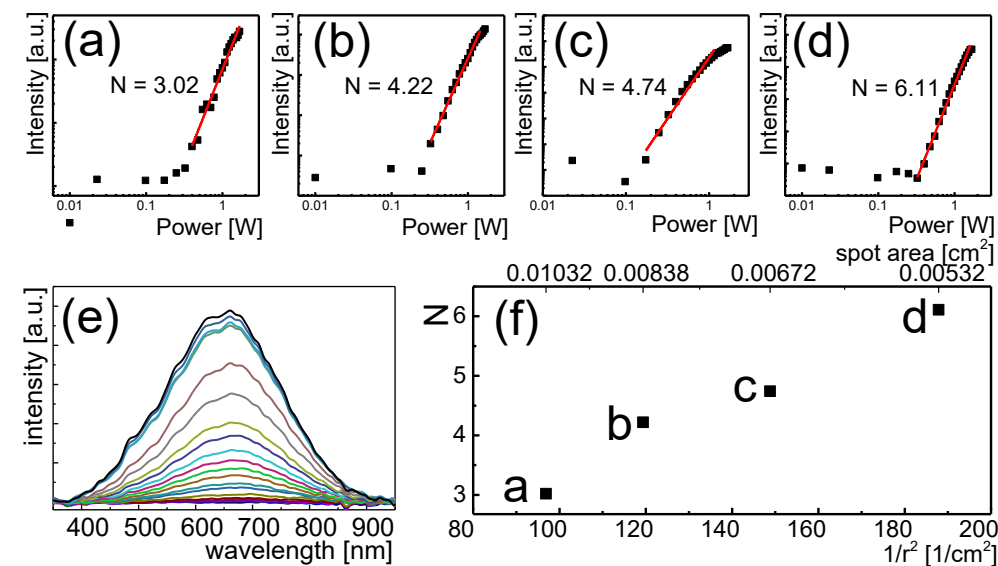
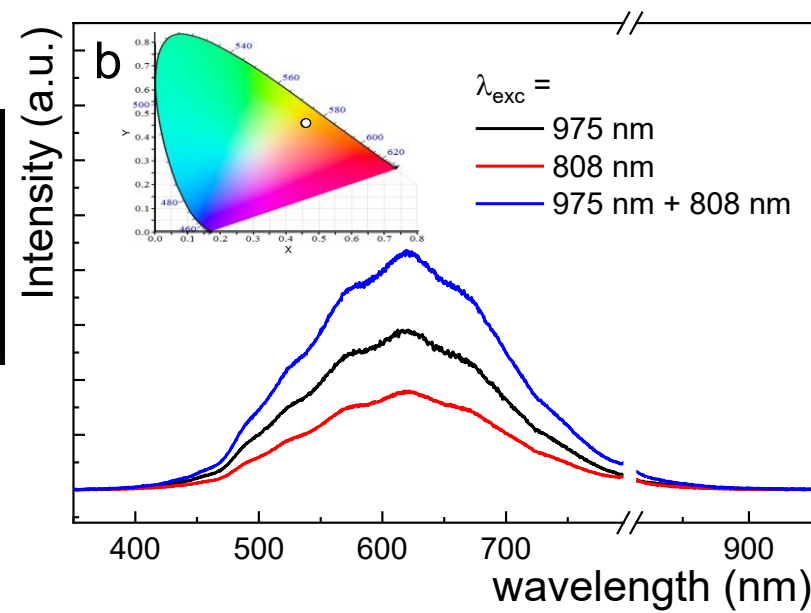
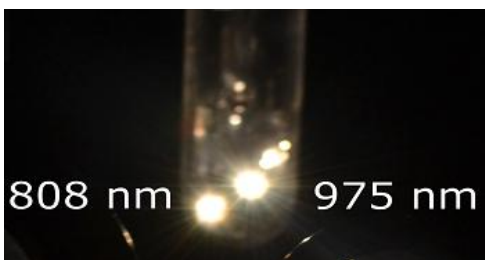
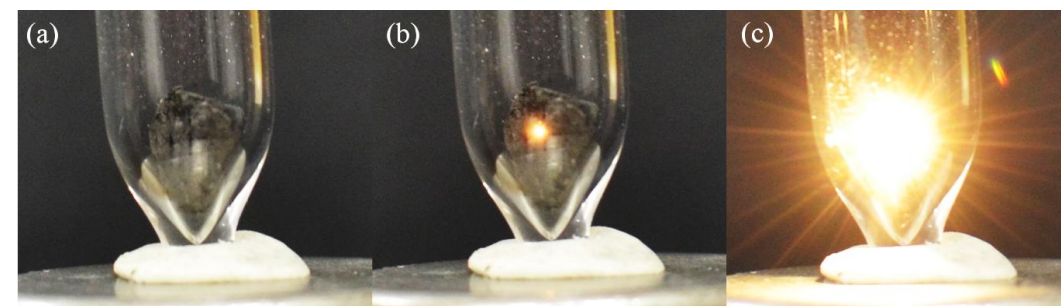
Graphene foam

www.nature.com/scientificreports

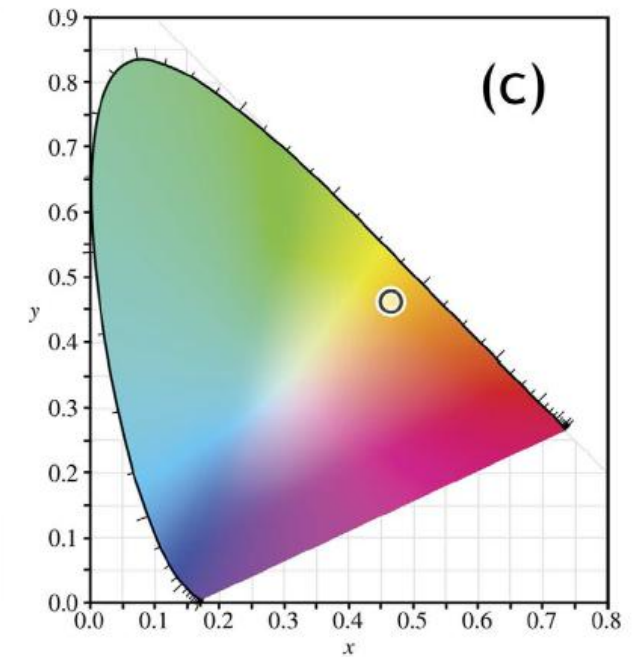
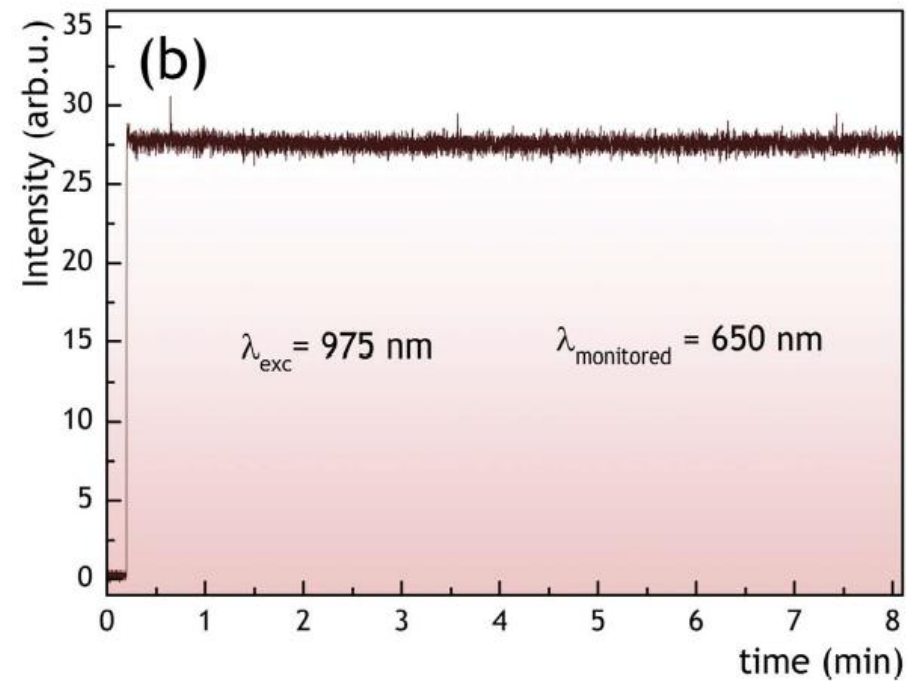
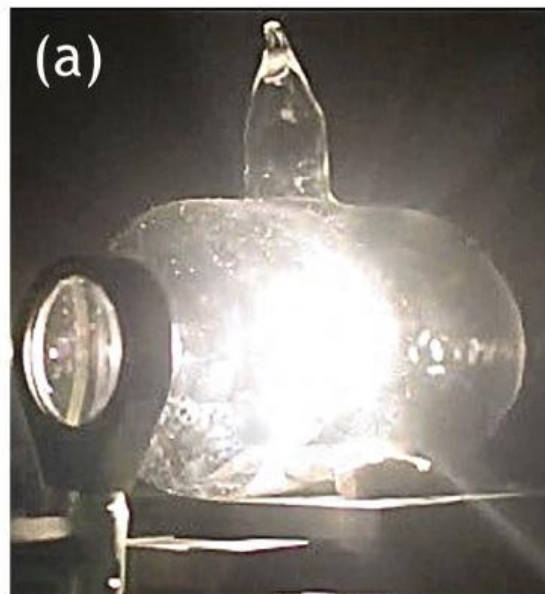
SCIENTIFIC REPORTS

OPEN Laser induced white lighting of graphene foam

Wiesław Strek, Robert Tomala, Mikołaj Łukaszewicz, Bartłomiej Cichy, Yuriy Gerasymchuk, Paweł Gluchowski, Łukasz Marciniak, Artur Bednarkiewicz & Dariusz Hreniak

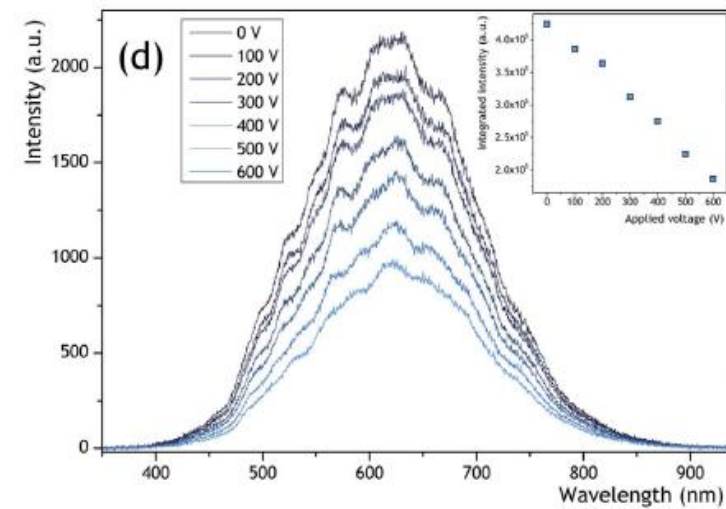
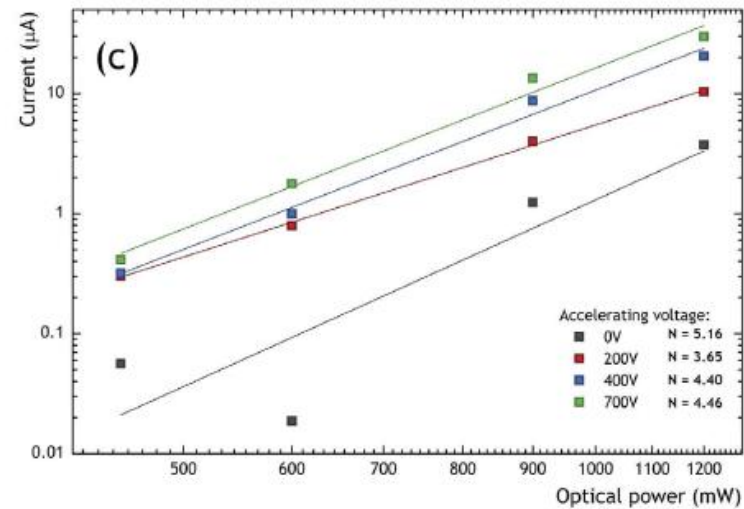
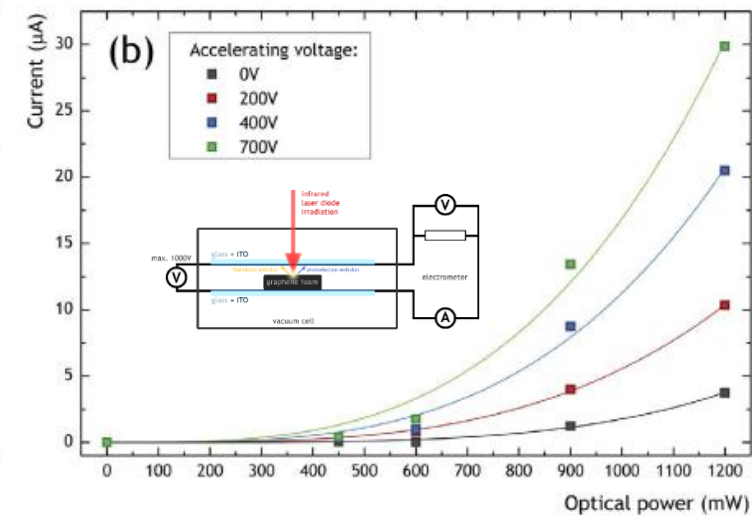
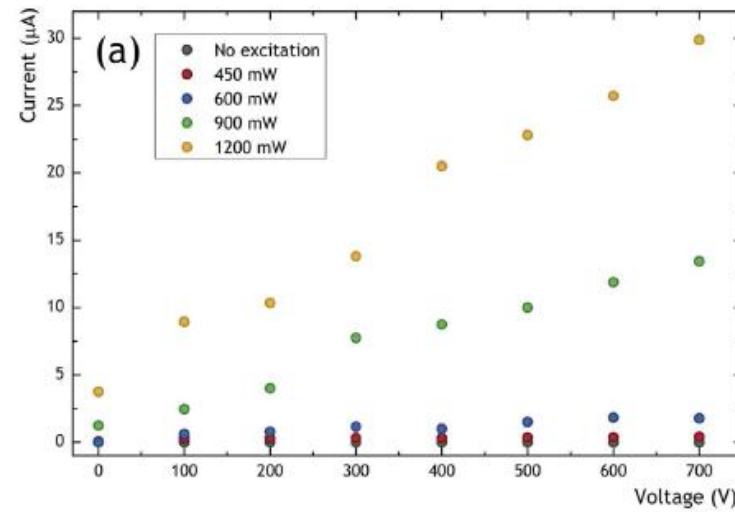


Emission stability

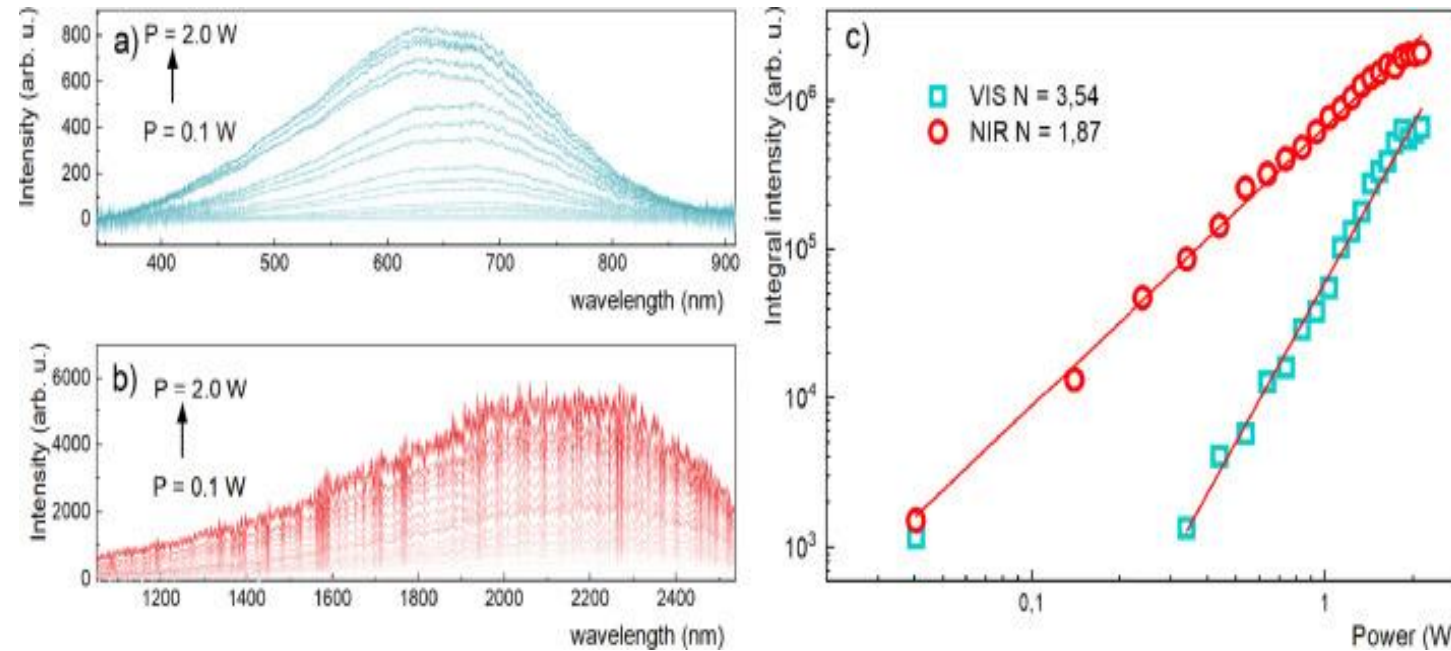
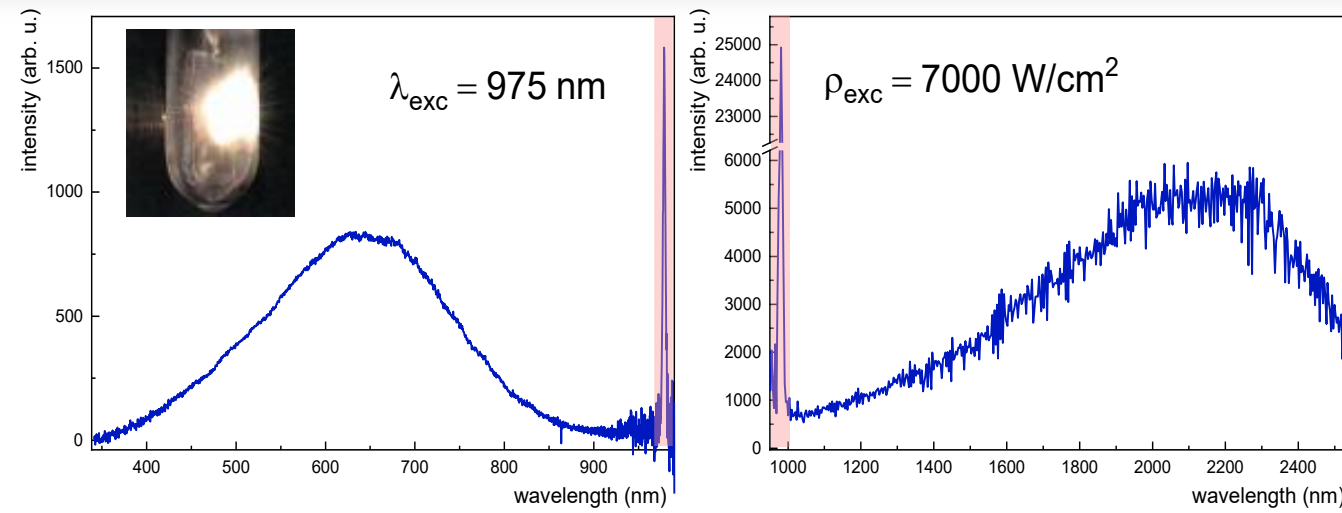


Photocurrent + hot electrons generation

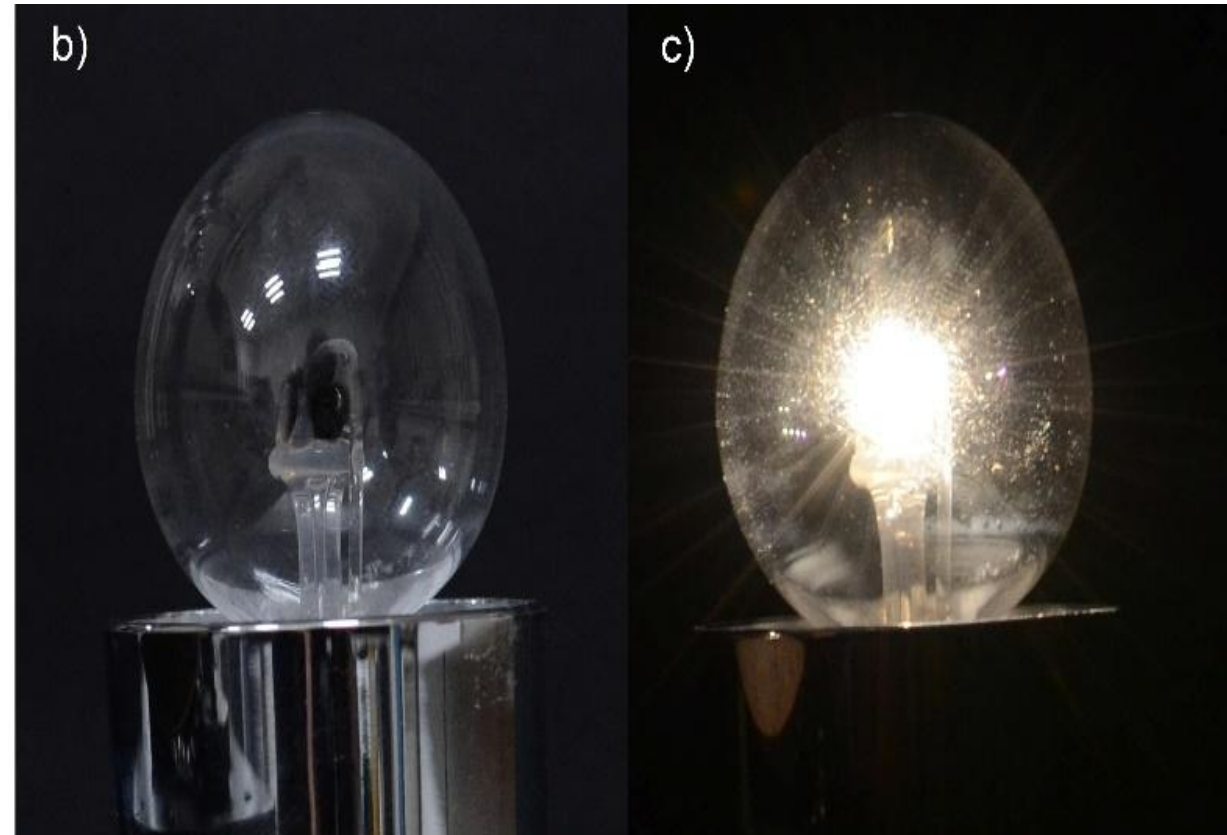
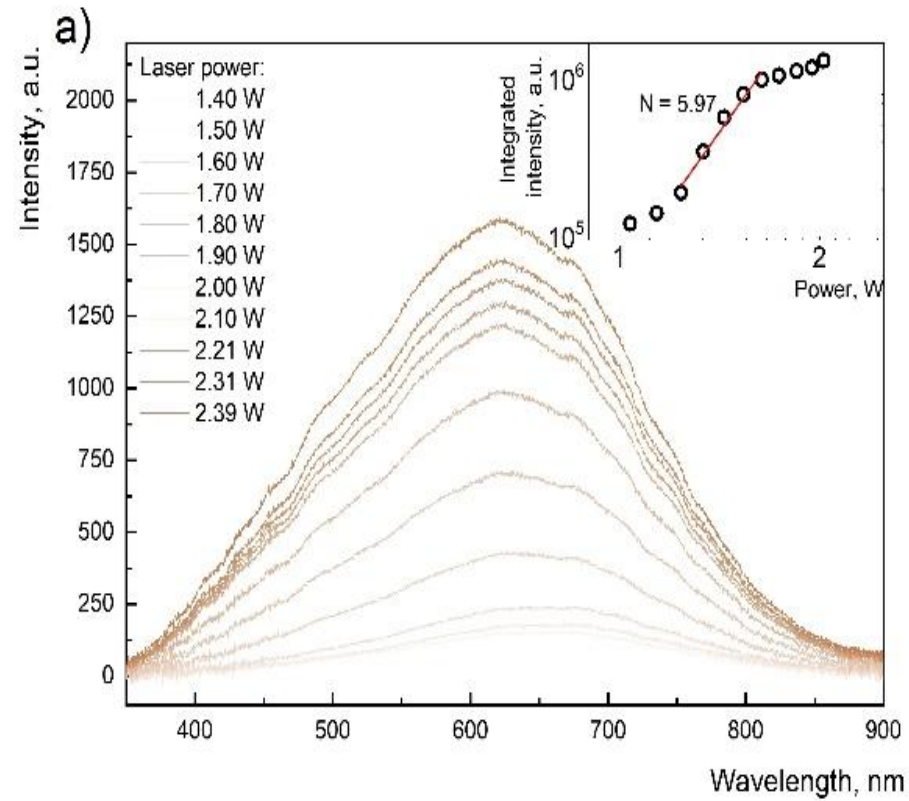
Applied electric field influence



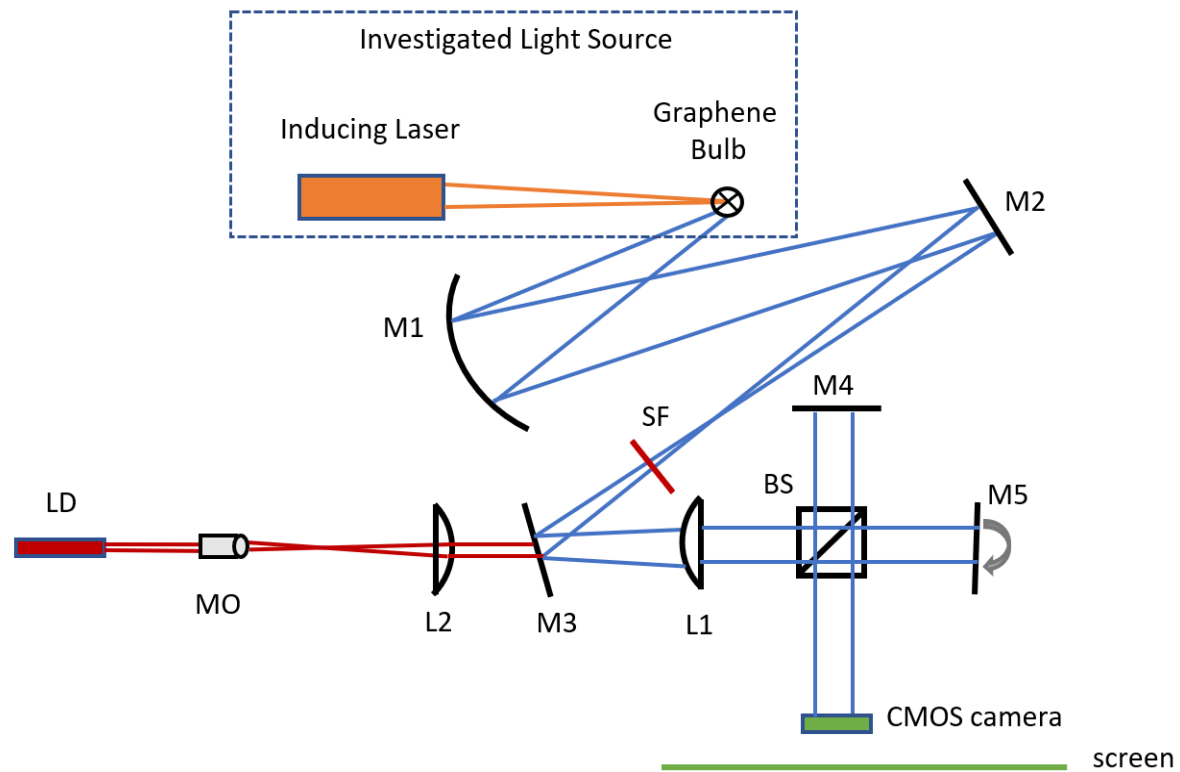
Graphene visible and IR broad band emission



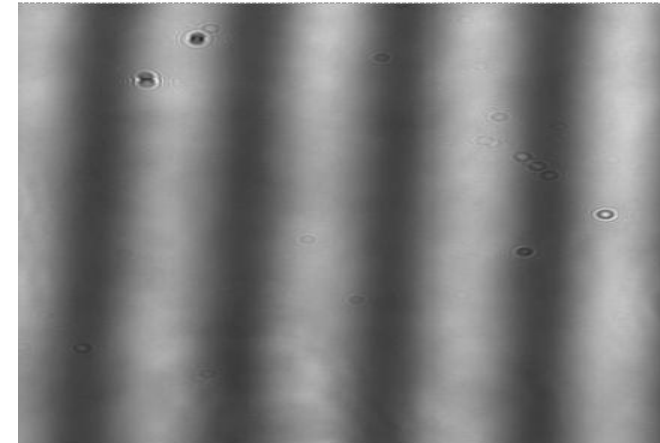
Coherence of LIWE of Graphene



Coherence properties of graphene light – entrance to White Laser?

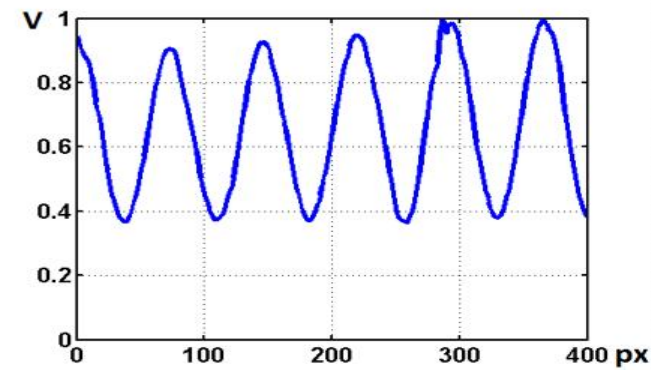


a



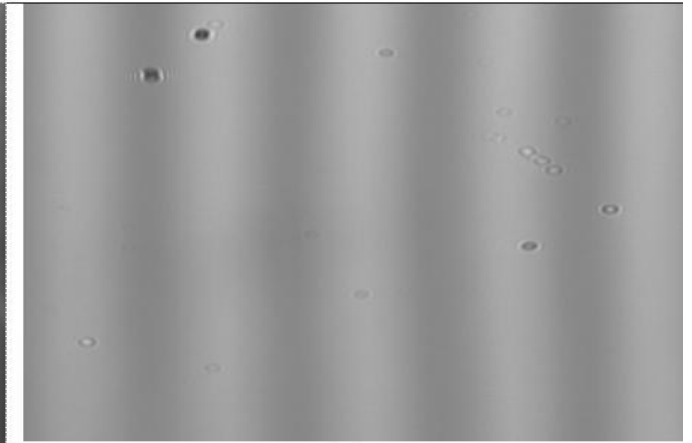
(a)

b



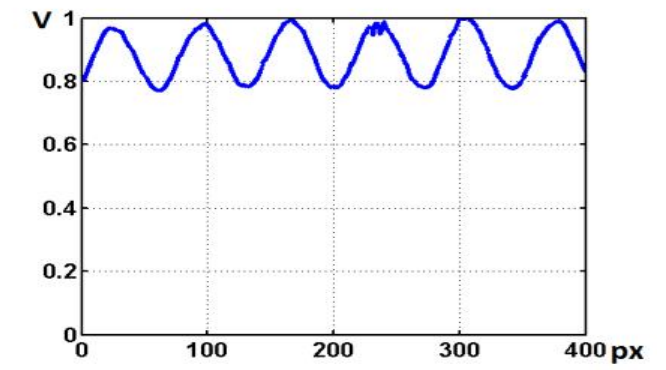
(c)

d

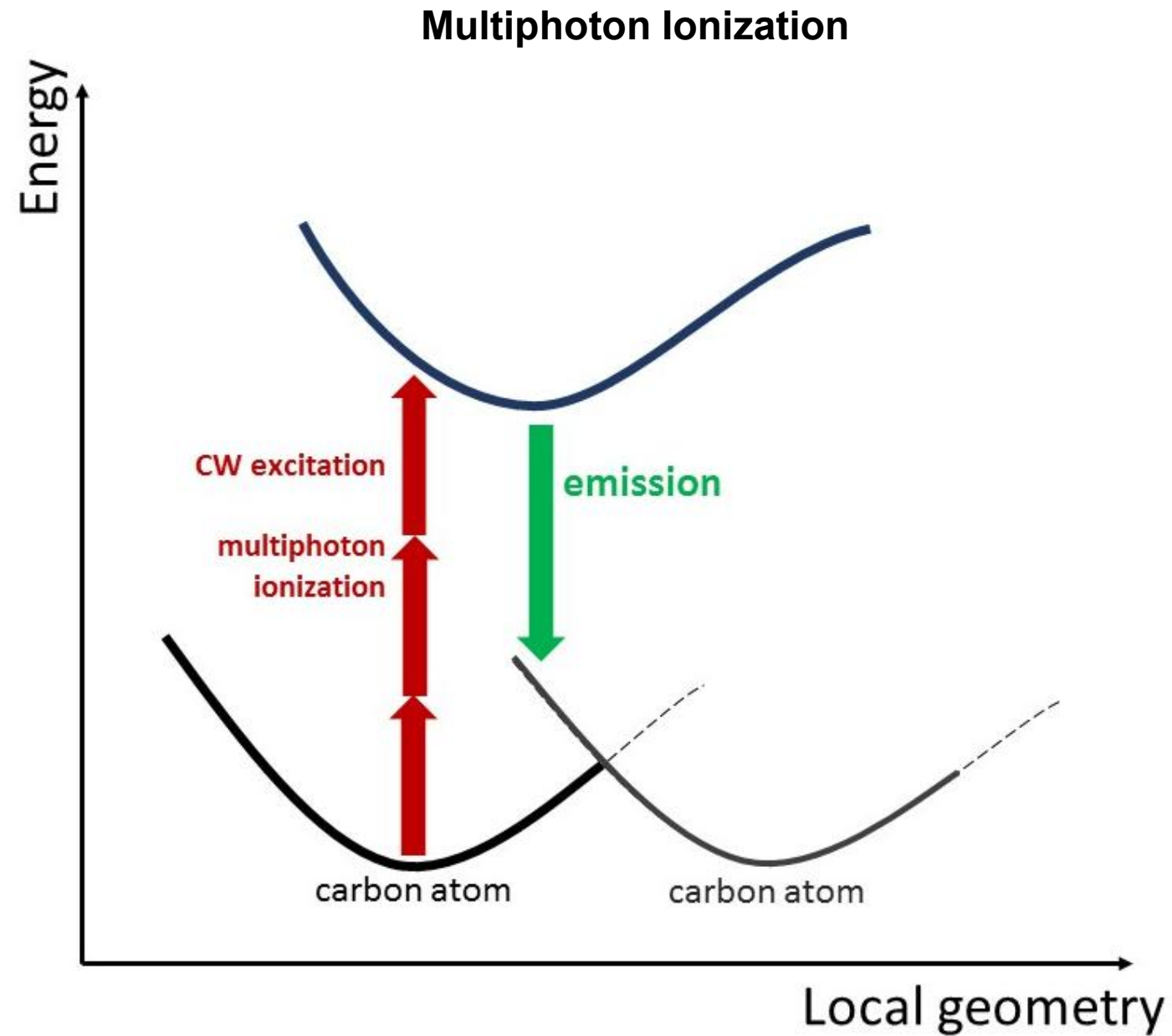


(b)

c

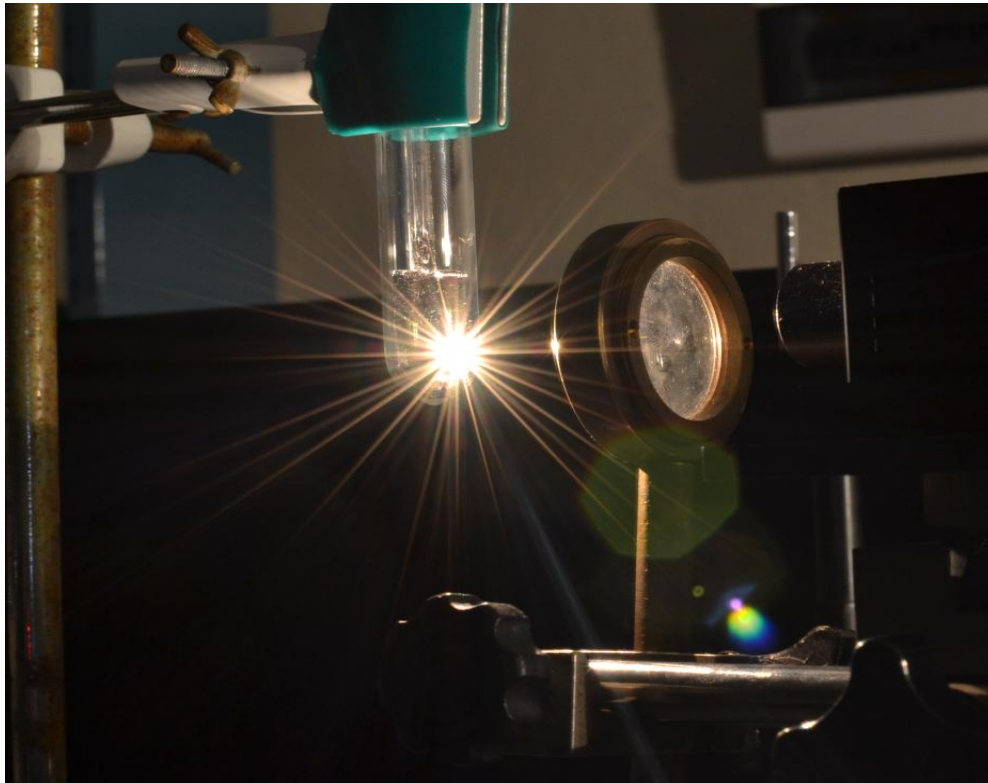


(d)



Graphene Broadband White Light Source

The development of Invention



The First Laboratory Demonstrator

Graphene as light source



Edison-type bulb

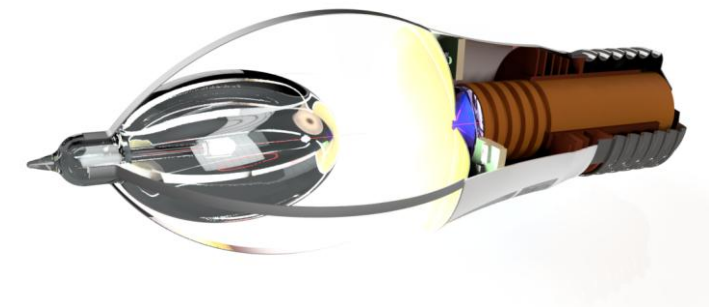
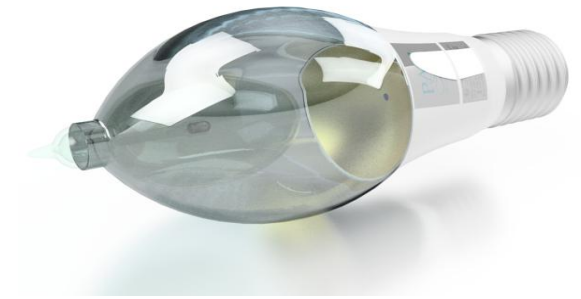
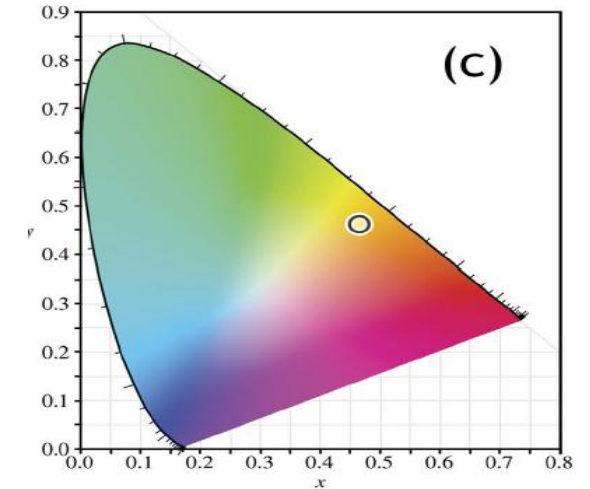
Laser Induced White Emission on Graphene Materials

The invention relates to a novel white light source to lighting applications.

The spectrum of light in visible range is similar to spectrum of the Sun.

The graphene based light source is characterized by:

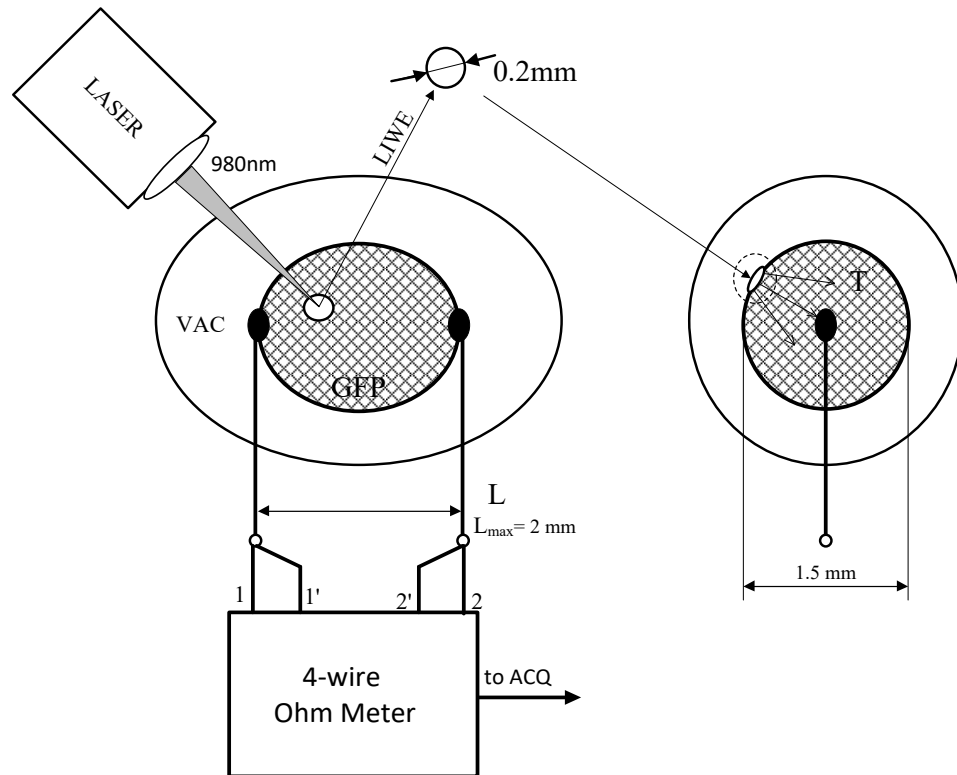
- high efficiency,
- broadband warm white light,
- cheap cost of graphene foam production,
- ecologic light source (not contain heavy metals and rare earth metals),
- long lifespan (>10 000 hours),
- ambient temperature has no effect on luminance efficiency.



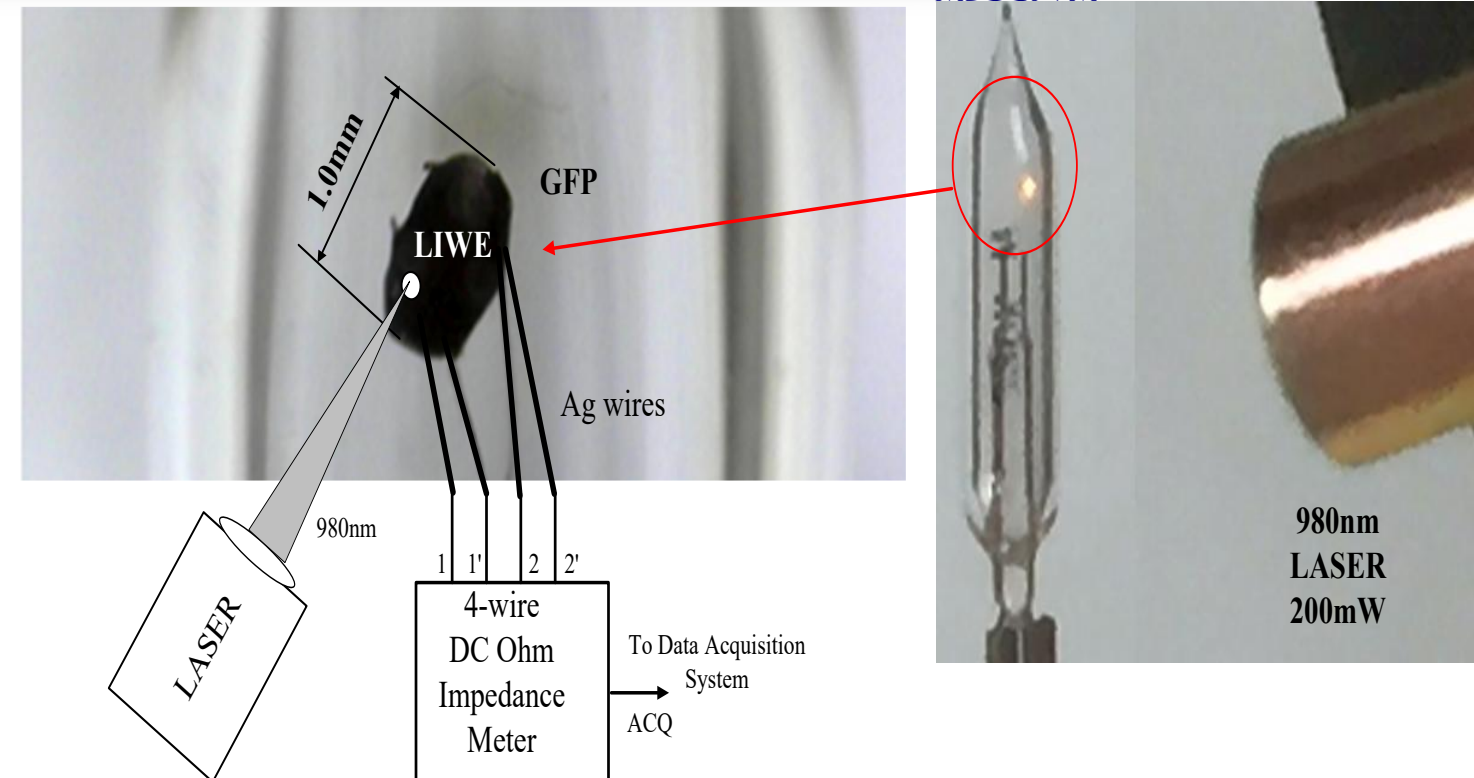
Recent investigations of photoresistivity of Graphene foam



(2026)



The measurement scheme of electric resistivity of graphene foam sample under irradiation with a focused beam of laser diode.



The photo of graphene foam sample with electrodes.

Chemical Physics Letters 893 (2026) 142848



Contents lists available at ScienceDirect

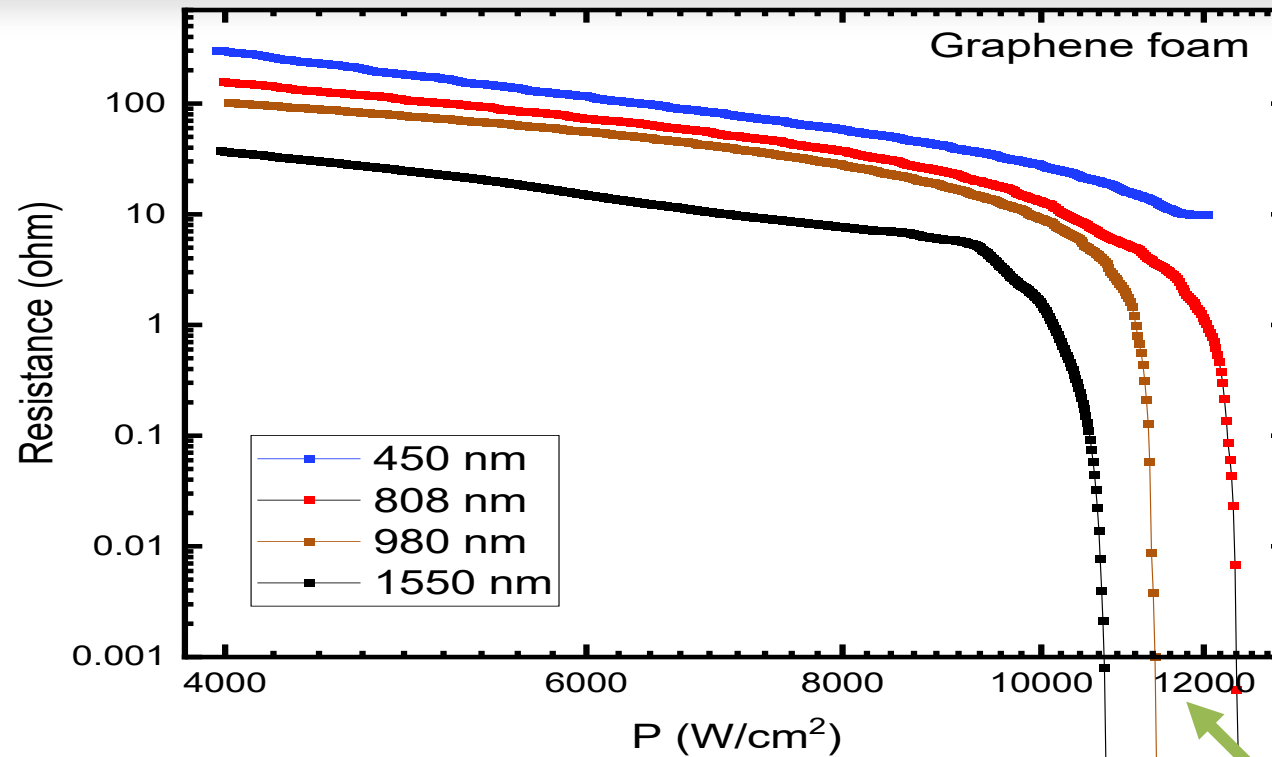
Chemical Physics Letters

journal homepage: www.elsevier.com/locate/cplett

Influence of laser-induced white emission on the resistivity of graphene foam

P. Wiewiórski, R. Tomala, M. Stefanski*, A. Musiałek, M. Samsel-Czekala, W. Strek

Institute of Low Temperature and Structure Research, Polish Academy of Sciences, 50-422 Wrocław, Poland



**Almost to zero !!
Superconductivity!?**

It is connected with a formation of photon coupled pair of electrons ($e-h\omega-e$).

- Efficient laser-induced white light generation is possible for graphene and graphene hybrid materials
- Large increase of the white light was observed for foamed graphene what suggest that significant field amplification may responsible for the effect
- The white light generation is accompanied by effective electronic emission
- Pressure dependence of the white light generation suggests that the emitted electrons may play a crucial role in the phenomena
- This phenomenon may be adopted in many novel technical applications i.e.
 - New phototransistors with galvanic isolation and tunable characteristics
 - Light sources without electric contact

Thank you for your attention!

E-mail: w.strek@intibs.pl