# Energy transfer depends on the number of graphene layers

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## Abstract

One of the fundamental processes, where graphene can be used is fluorescence resonance energy transfer (FRET). The requirement of spectral overlap between emission of a donor and absorption of an acceptor is in this case easily fulfilled as graphene exhibits flat and efficient absorption across the whole visible spectral range.[1] The efficiency of the energy transfer depends also on a distance between an emitter and graphene surface. The two main spectroscopic consequences of FRET are: quenching of donor emission and shortening of the donor fluorescence lifetime.[2,3]

In this work we focus on the factors that determine the graphene properties as the energy acceptor. As a donor we used natural photosynthetic complexes, which exhibit rather strong fluorescence and broad excitation range (from 400 nm to 650 nm).[4] In particular we studied the dependence of FRET efficiency on the number of graphene layers (from 1 to 8) and also examined impact of a substrate supporting graphene. We used four samples with ranged number of layers: single layer graphene, bilayer graphene, 3-5 layers of graphene and 6-8 graphene layers. For substrate examination we used four substrates with a single layer graphene: silicon, silica, polyethylene terephthalate and glass. Fluorescence spectra and lifetimes were measured using confocal fluorescence microscopy and time-resolved fluorescence spectroscopy.

The efficiency of the observed FRET from natural photosynthetic complexes to graphene depends on the number of graphene layers and decreases with each layer. This dependence is also affected by the excitation energy, showing higher variations of FRET efficiency for higher excitation energy. For substrate measurements we can distinguish two groups of substrates: semiconductor (silicon) and insulators (silica, glass, polyethylene terephthalate). The resulting FRET shows higher efficiency for insulators. The results indicate that the energy transfer to graphene can be controlled by the variation of graphene structure on different/appropriate substrates as well as the excitation energy.

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## References

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