Why is luminescence quenched in zigzag tubes?

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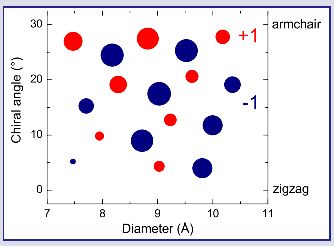
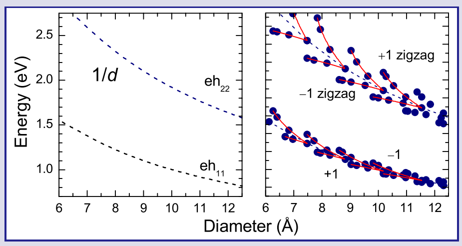
We show that the photoluminescence intensity of single-walled carbon nanotubes is much stronger in tubes with large chiral angles - close-to armchair tubes - because exciton resonances make the luminescence of zigzag tubes intrinsically weak. Close-to armchair tubes do not grow preferentially with present growth techniques; they just have stronger luminescence.

Intensity depends on family & chiral angle

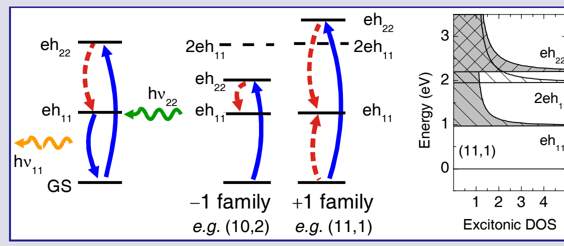


Miyauchi *et al.*, CPL (2004).

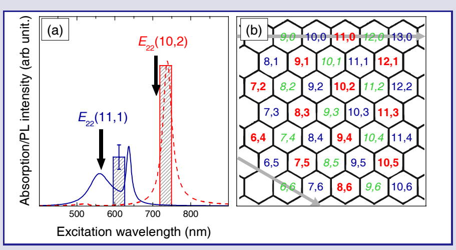


Reich *et al.*, PRB (2002); Kane & Mele (2004).

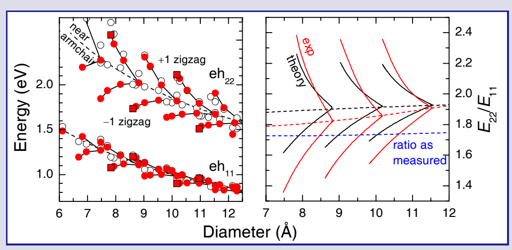
Exciton decay for -1 and $+1$



Absorption line shape



Red shift of the eh_{22} transition

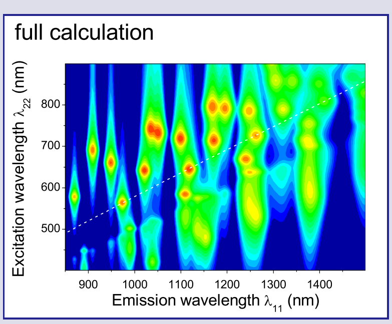


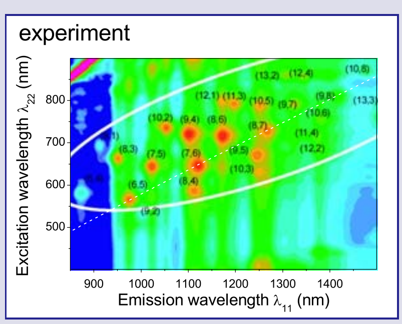
absorption calculated with a Green's function approach [Kane & Mele (2003)]

$h\nu_{11}$ and $h\nu_{22}$ from experiment [Bachilo (2002), Lebedkin (2003)]

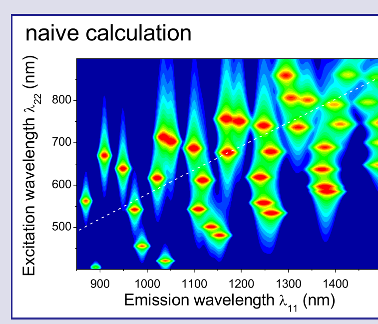
self-consistent procedure to find eh_{22}

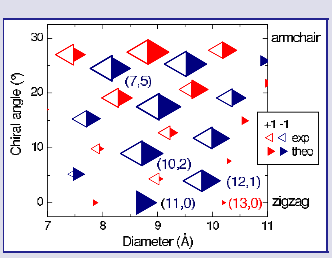
Calculated photoluminescence maps





Bachilo *et al.*, Science (2002).





Experiment: Miyauchi *et al.*, CPL (2004).

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Conclusion

Exciton-exciton resonance explains dependence of the nanotube PL intensity on chiral angle

Asymmetry between the -1 and $+1$ nanotube family, because resonance occurs mainly in $+1$ tubes with small chiral angle

Luminescence intensity reflects absorption of the individual tubes, not the chirality abundance of tubes in the sample

Maxmimum of eh_{22} transition is red-shifted with respect to the exciton energy