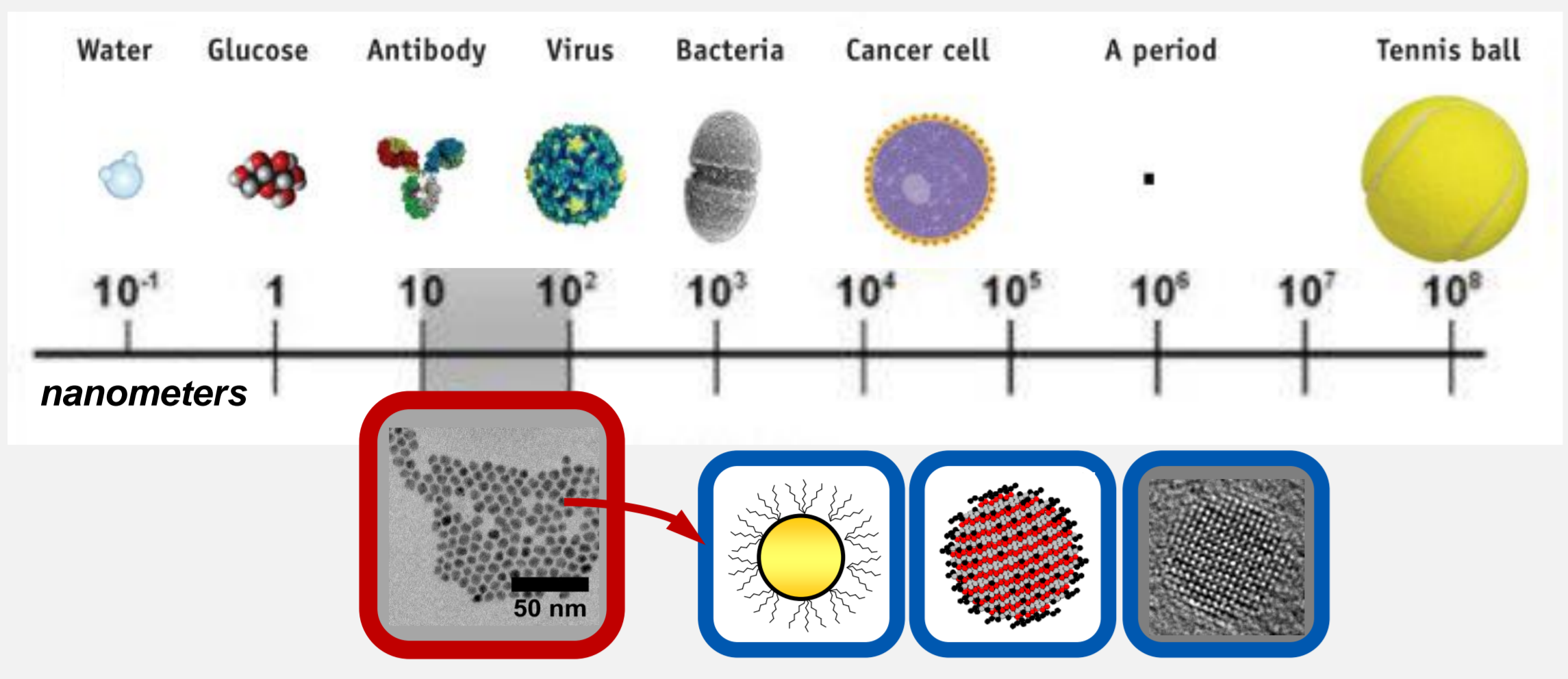


APPLICATIONS OF COLLOIDAL NANOCRYSTALS

Sofie Abé | Philippe F. Smet | Zeger Hens

NANO = SMALL

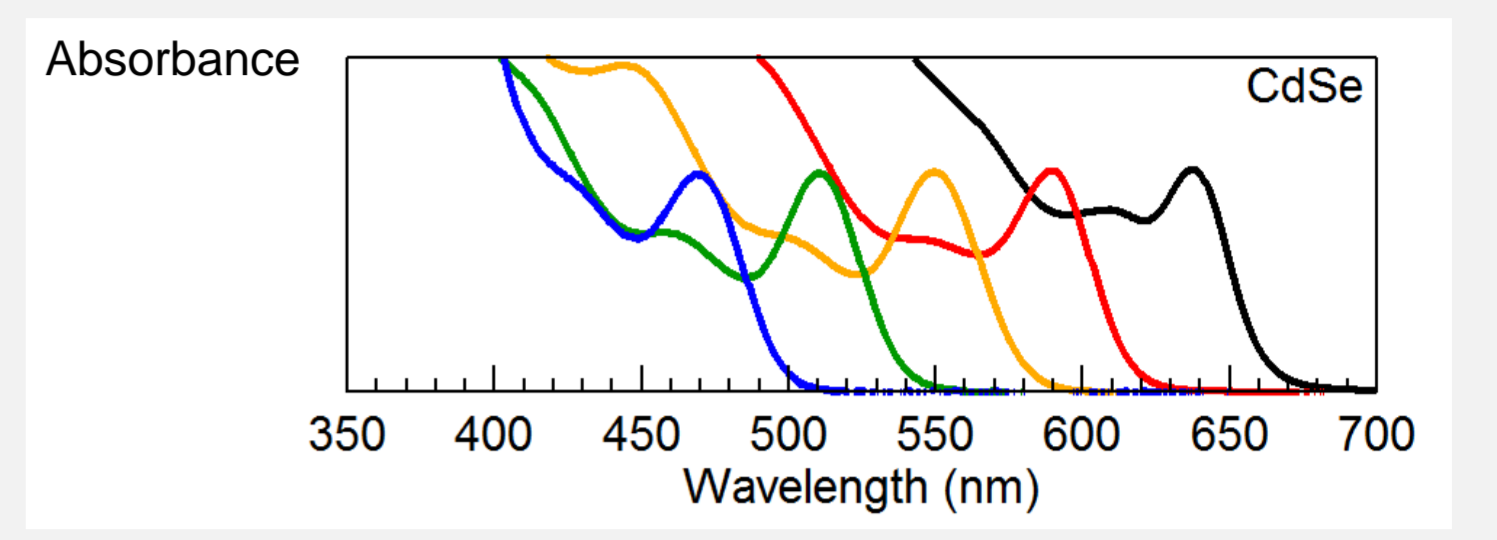


NANO = ALSO DIFFERENT

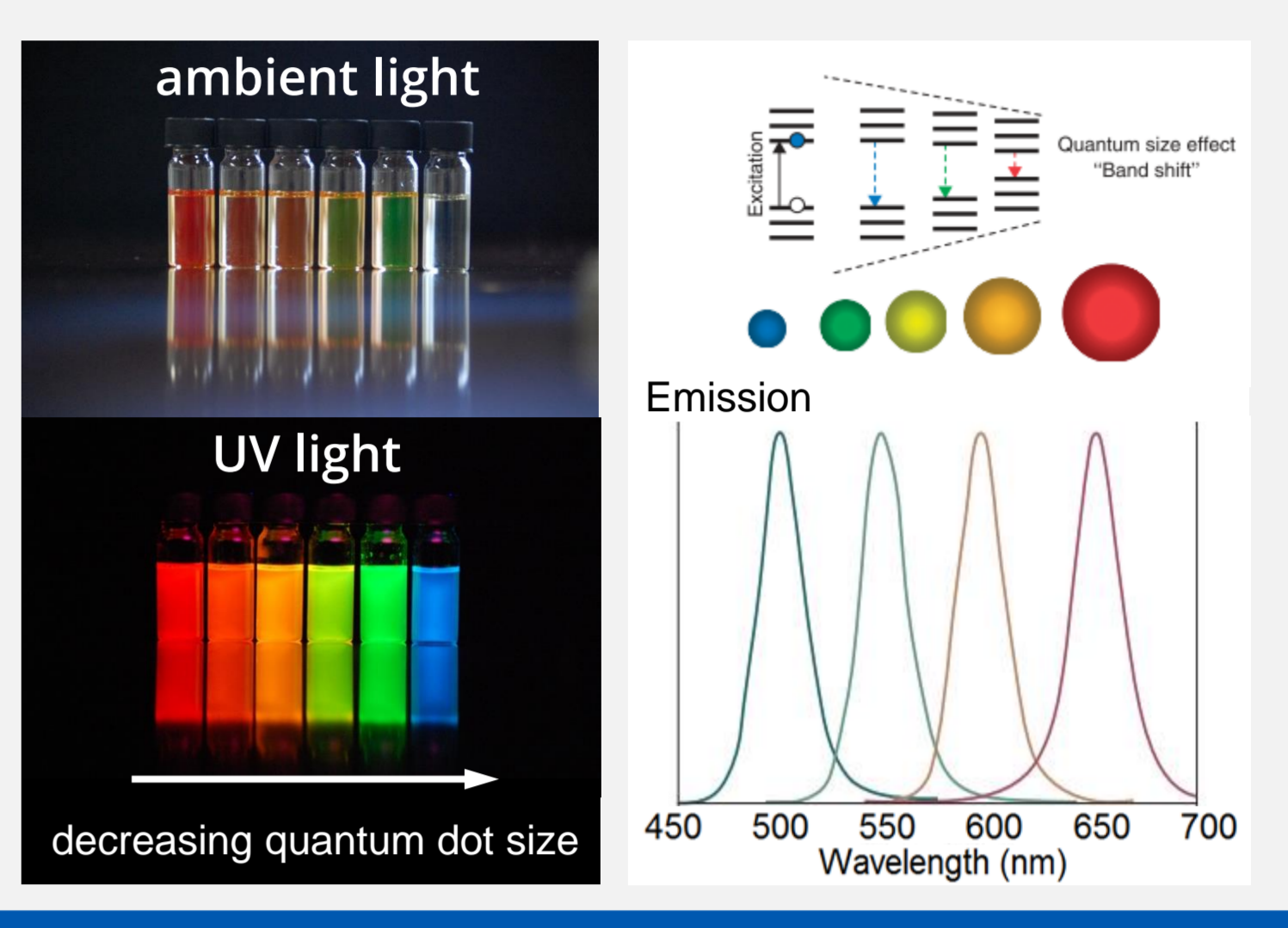
Physical properties of a piece of metal or semiconductor of
 5 g and 5 kg = the same
 2 nm³ and 5 nm³ = different from bulk and each other

QUANTUM DOTS ARE LUMINESCENT

Colloidal semiconductor nanocrystals – quantum dots – absorb photons in a wide wavelength range and emit photons with lower energy.



The emission wavelength can be tuned by adjusting the quantum dot diameter.

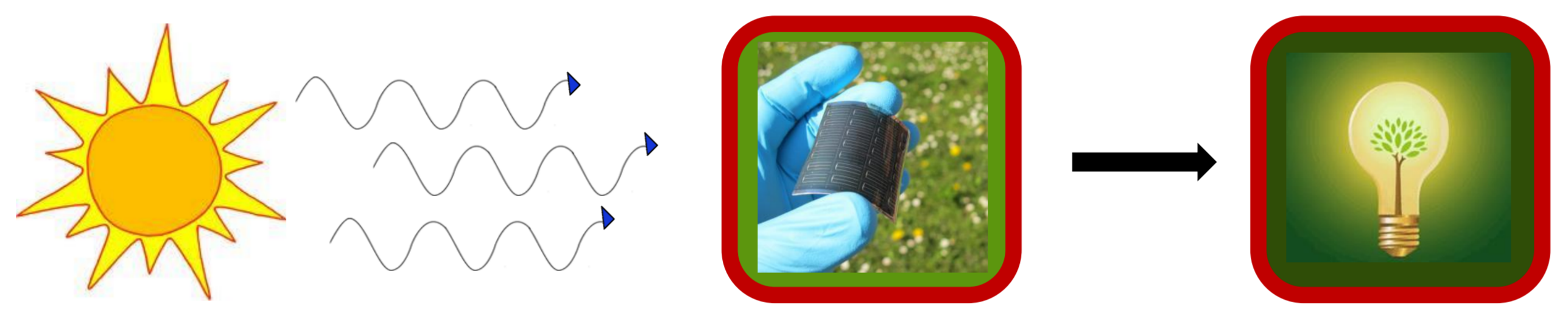


With one type of material (CdSe, PbS, InP, CuInS₂,...) conversion to different colours – or even IR – can be achieved.

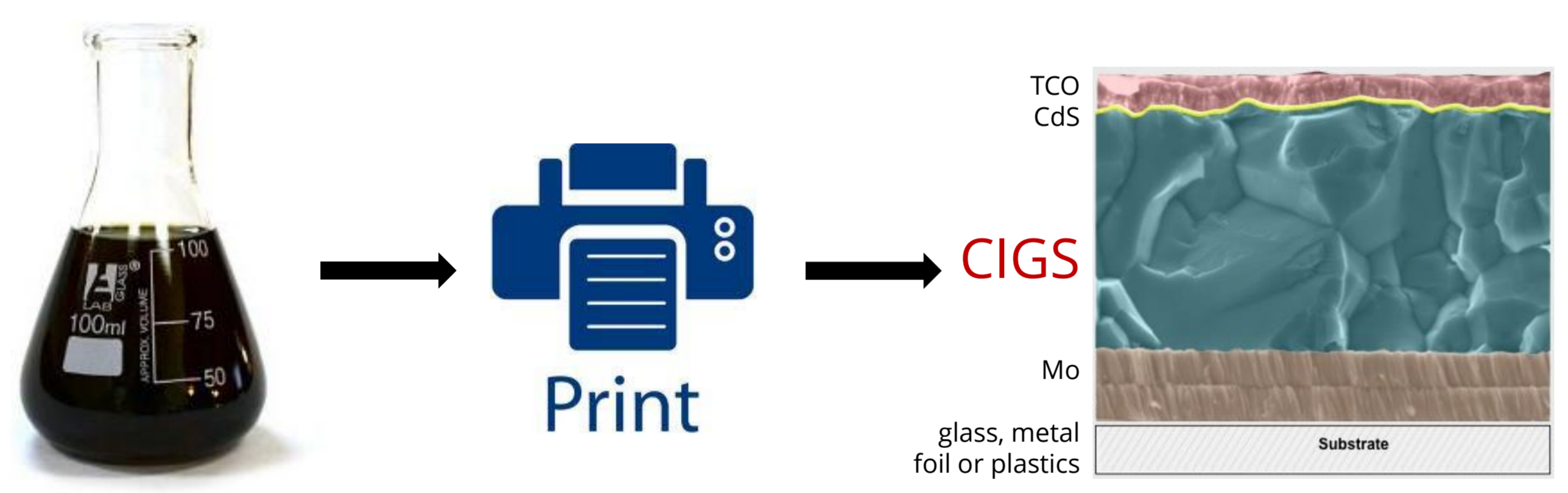
motivation synthesis = well controlled tunable emission colour, broad absorption range
 easy solution-based processing can be combined with different technology platforms

ABSORBER MATERIAL FOR SOLAR CELLS

Semiconductor layers in solar cells absorb sunlight and convert it to electricity, creating green energy.



Colloidal nanocrystals (CIGS) form a stable ink which can be printed on any surface before annealing to bulk CIGS.

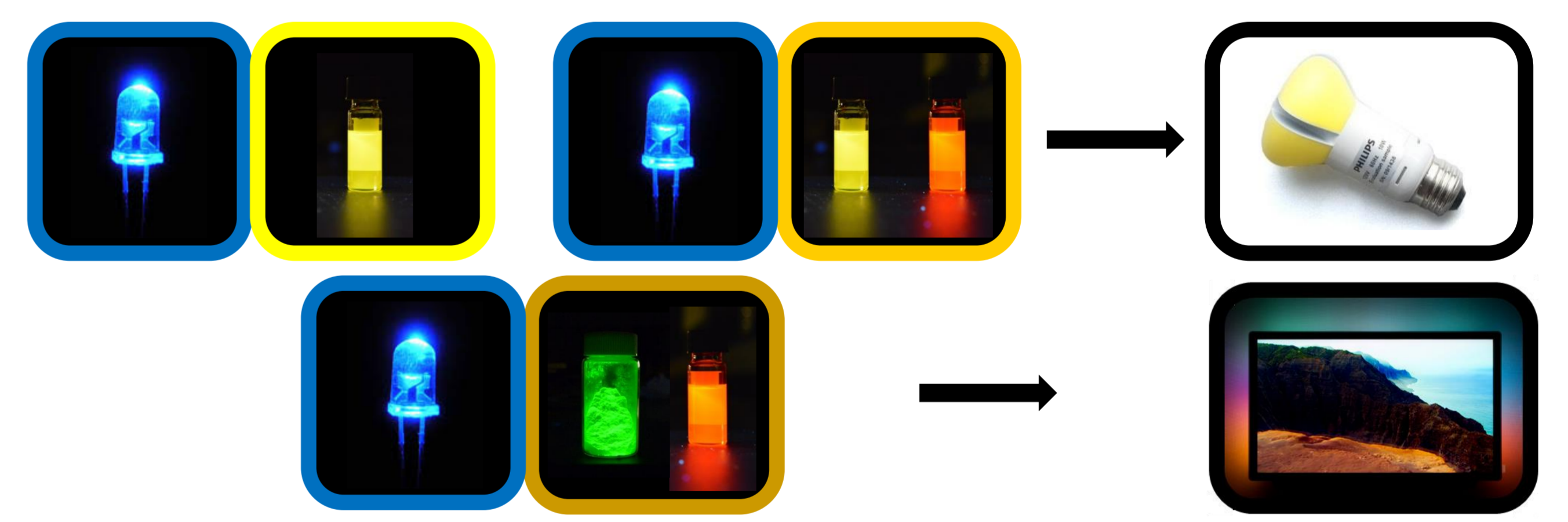


WHITE LED COLOUR CONVERTOR

Part of the blue LED light needs to be converted to yellow (+ some red) to obtain (warm) white light.

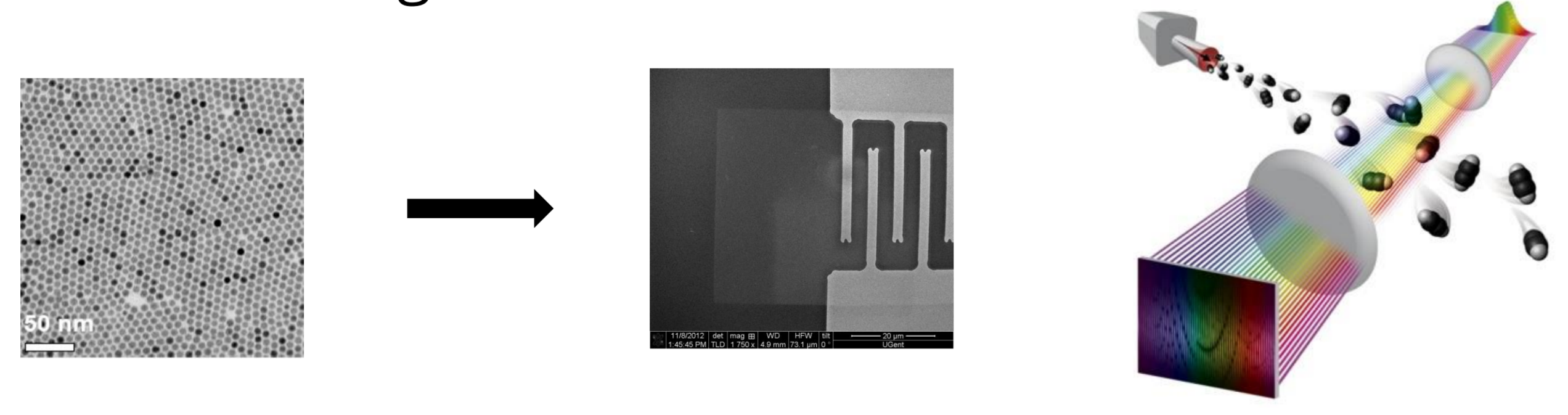
white LED = **blue LED** + **colour convertor**

White LEDs for lighting or displays require a proper combination of yellow, red and/or green colour convertors: quantum dots, phosphors or a combination of both.



ABSORBER MATERIAL FOR PHOTODETECTORS

Cheap and performant photodetectors in the mid-IR range are needed.



Device fabrication requires patterning of QD layers.

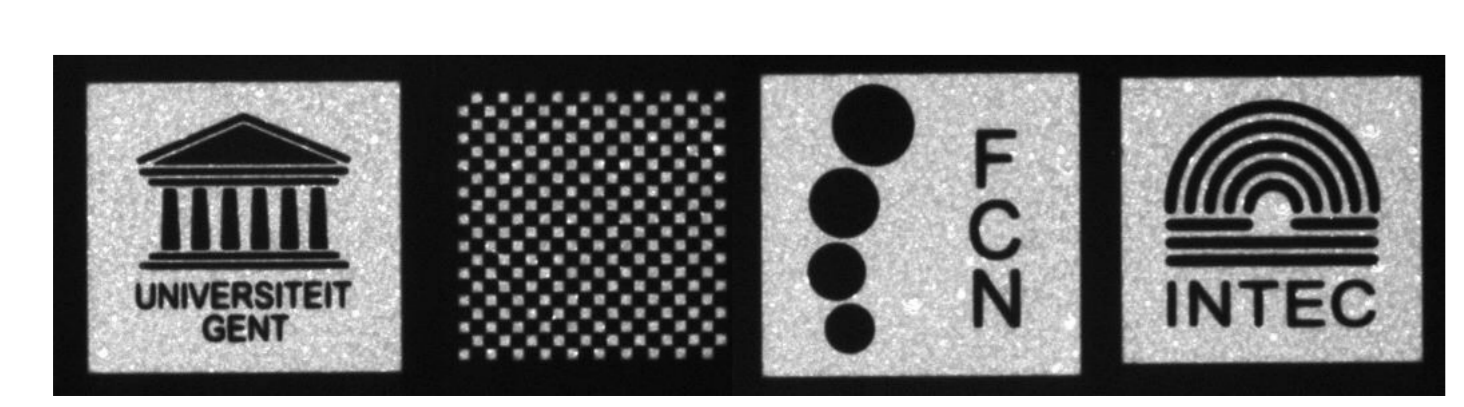
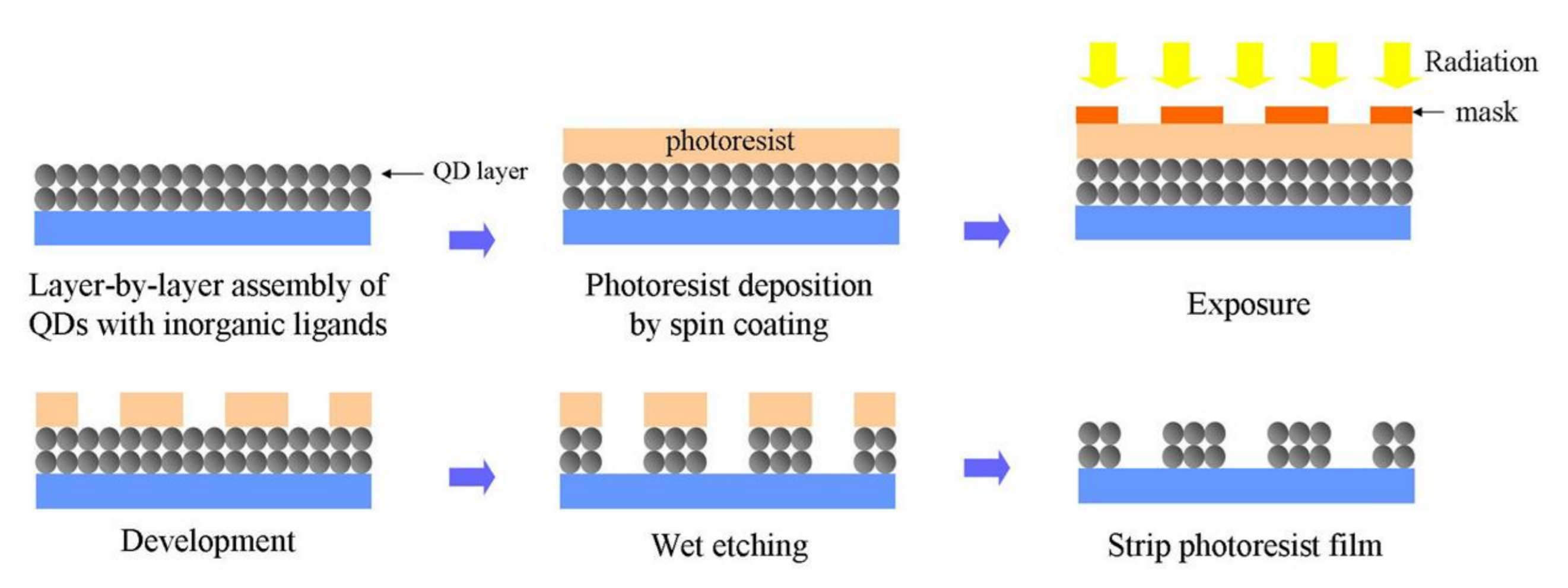
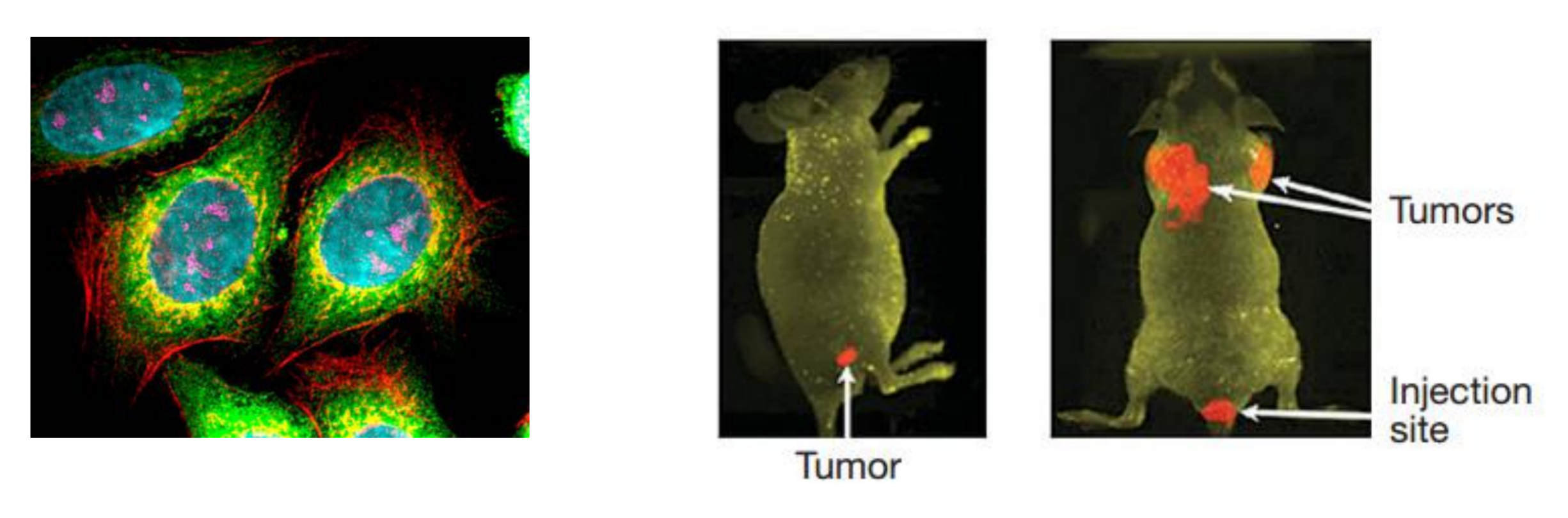


image constructed with fluorescence microscope

FLUORESCENT BIOLABELS

In vivo imaging of cells and organisms with fluorescence microscopy requires stable luminescent labels that attach to specific cell organelles, cells, tissues or organs.



Quantum dots can be linked to target proteins, antigens or other functional molecules (drugs etc.) and allow simultaneous imaging of multiple targets due to their narrow emission (multiplexing).

