Nanoparticles and Conjugation

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Nanoparticles in relation to lateral flow technology

Nanoparticles provide the basis for detection and visualisation of specific targets.

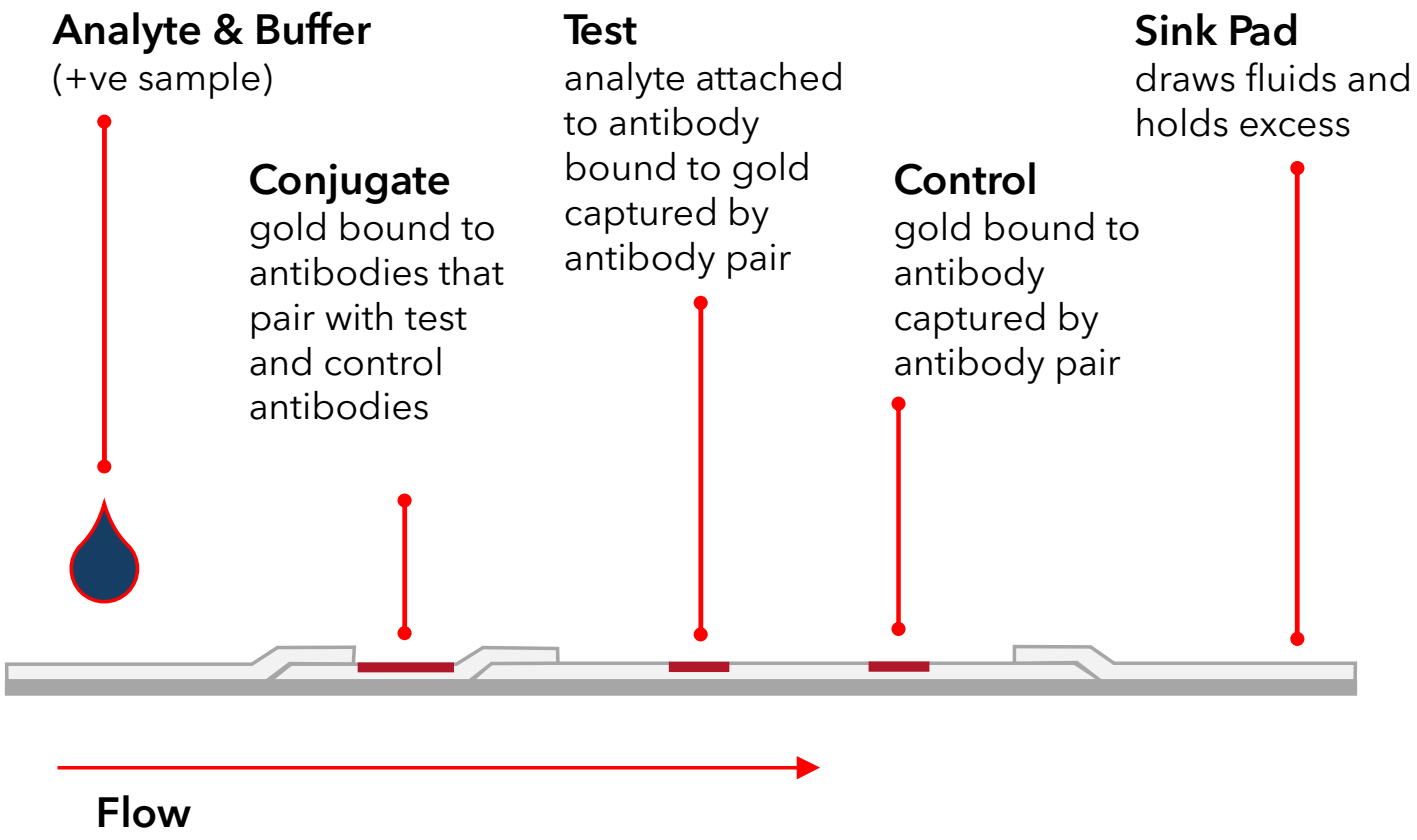
These tiny particles, often measured in nanometres, are engineered to bind to specific molecules, making them ideal for rapid and sensitive diagnostics.

Conjugation in relation to lateral flow technology

Conjugation is a critical process in lateral flow technology, involving the binding of a specific molecule, often an antibody or antigen, to a solid support like a nanoparticle.

This binding is crucial for the detection of target analytes in the test.

Standard conjugation (Gold nanoparticles)



Types of Nanoparticles

- Coloured Latex
- Gold
  - Round
  - Nanorods
- Selenium
- Fluorescent
- Europium
- Conjugated Polymer Nanoparticles (CPNs)
- Paramagnetic particles

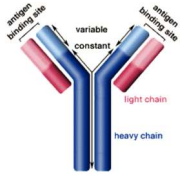
… and others

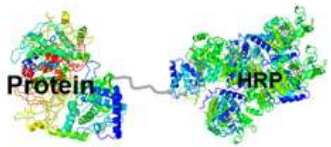
Conjugation methods

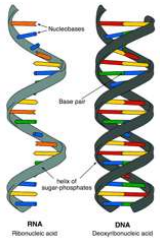
- Absorption
- Chemical coupling
- Biotin – Streptavidin coupling

Molecules that can be conjugated

- Antibodies
- Protein Conjugate
- Aptamers
- Affirmers
- RNA/DNA







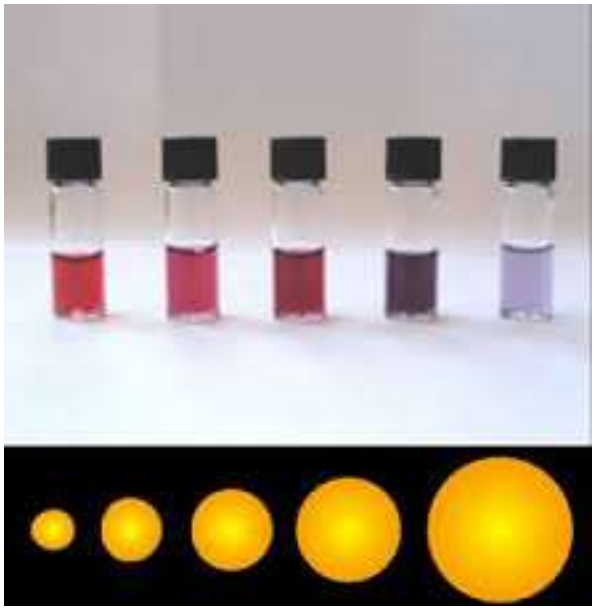
… and others

Gold

Gold nanoparticles contrast well against the white background of nitrocellulose

Larger particles do not produce more sensitive assays

40nm to 60nm is optimum for colour and contrast



Gold

Gold nanorods can give different colours

RAPIvD

Pioneers in rapid *in vitro* diagnostics

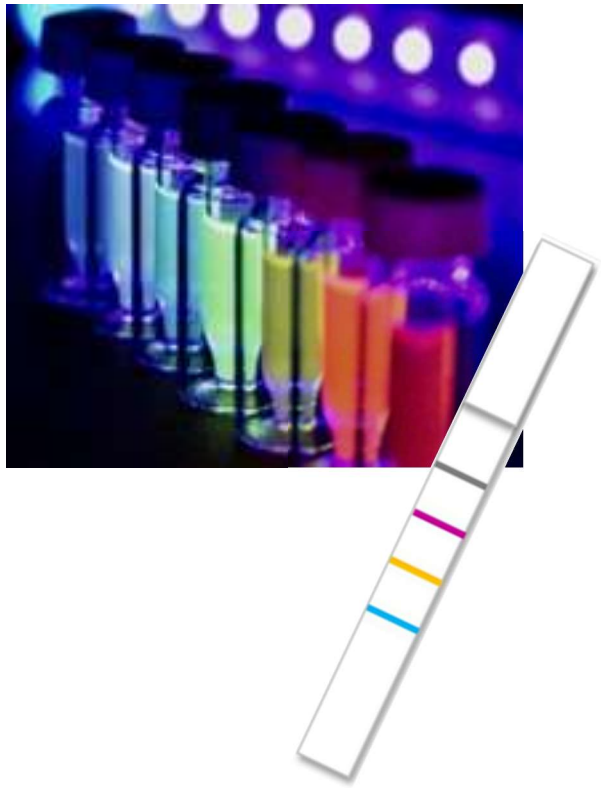
Conjugated Polymer Nanoparticles (CPNs)

water-soluble light
emitting polymer

~ 70-80nm in size

luminescence or
fluorescence covering
the visible and IR spectrum

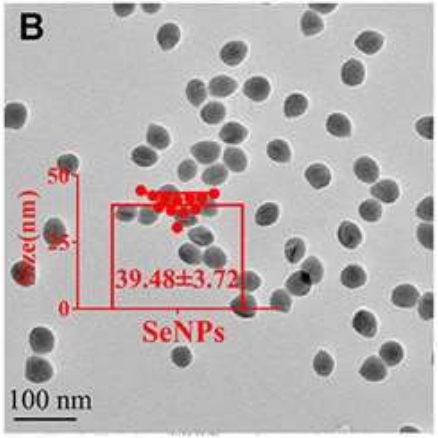
Bonds to molecules via EDC coupling,
maleimide coupling or click chemistry



Selenium Nanoparticles

Dark brick red particle

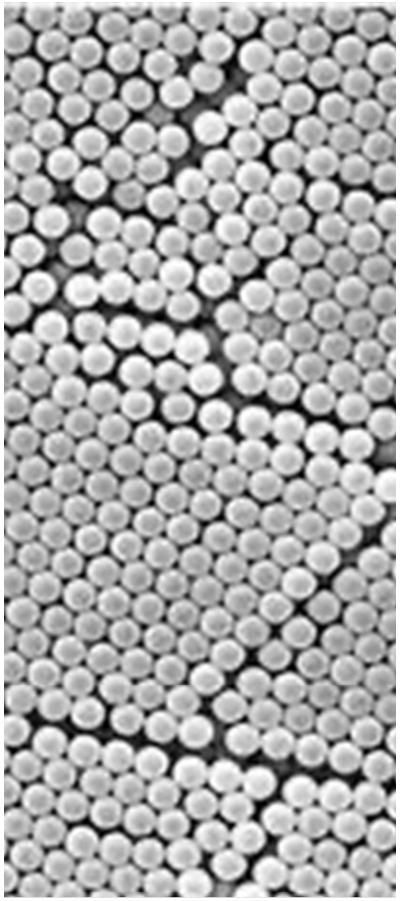
Shown to give great contrast and better sensitivity than its gold counterpart



Latex Particles

First lateral flow test used latex particles (ClearBlue)

- Extremely uniform particles
- Easily coloured with optical/fluorescent dyes
- Surface chemistry can be altered
- Can be made para-magnetic



Conjugation method – passive absorption

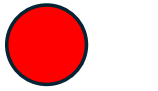
Add the bio molecule to the particle mixture and wait

Not quite that easy.

Considerations:

- pH of the reaction
- Buffer type
- Biomolecule loading
- Blocking proteins and buffer
- Speed of mixing
- Co-conjugation for lower levels of antibody on surface

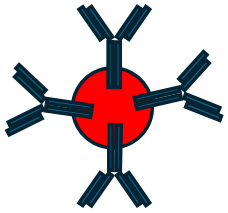
Conjugation method – passive absorption



plus

antibody

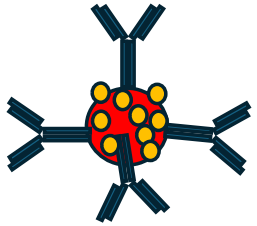
stir for 1 hour



plus

blocker

stir for 1 hour



plus

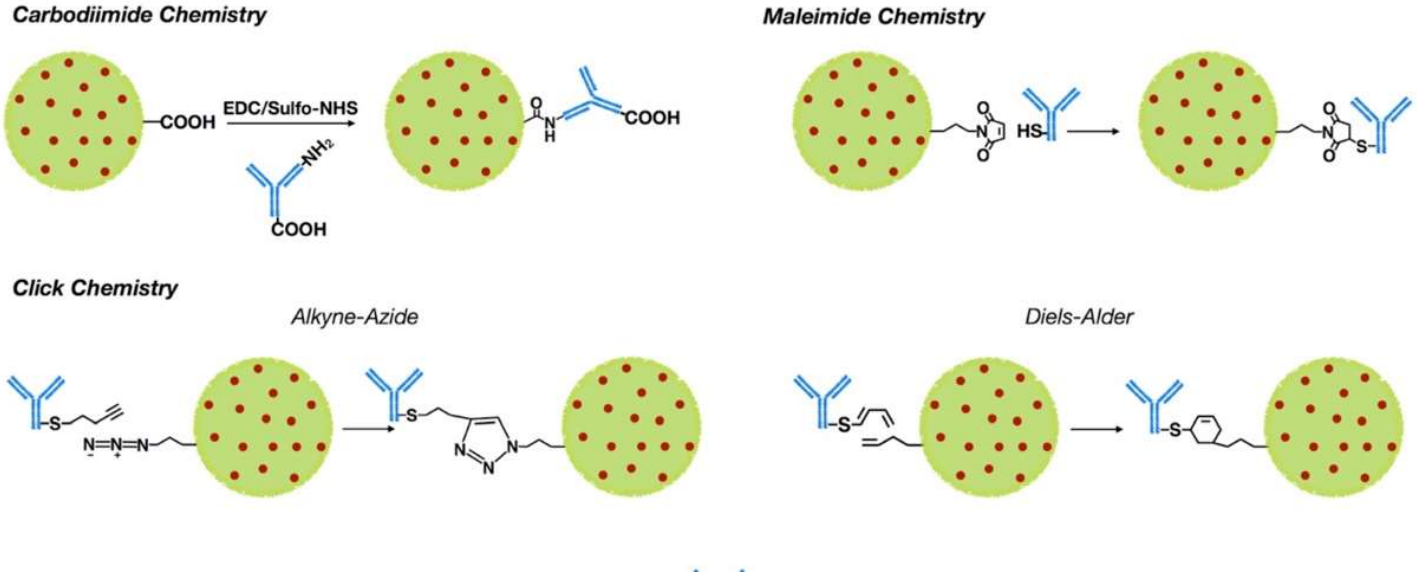
storage buffer

long-term conjugate happiness

Conjugation method – chemical coupling

About one in ten antibodies are active with passive absorption – expensive

∴ some prefer chemical conjugation



Ref: https://www.mdpi.com/pharmaceutics/pharmaceutics-12-00802/article_deploy/html/images/pharmaceutics-12-00802-g001.png

More Considerations

Nanoparticles/conjugation account for a fraction of the total number of variables that need to be considered when developing a lateral flow device.

It’s complicated


It’s alchemy
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Thank you

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