Upconversion Nanoparticles as labels for histopathological tissue evaluation

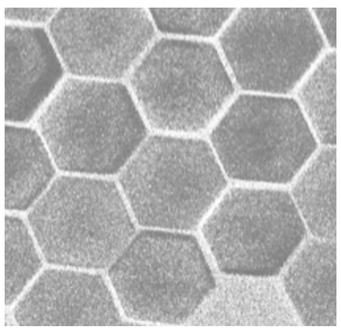
Krzysztof Krawczyk[1], Matthias J. Mickert[1], Stefan Andersson-Engels[2] . [1]Lumito AB, Lund, Sweden; [2]Tyndall National Institute, Ireland.

Background

In the field of histopathology misdiagnosis is a great risk. For decades H&E stains together with HRP and DAB as a chromogenic substrate, have been the gold standard to visualise tissue morphology and to detect markers of interest. However, these methods suffer from a narrow dynamic range, difficulties in quantification and limited possibilities regarding multiplexing. Fluorescent IHC techniques open the possibility for a quantitative readout but suffer from photobleaching and spectral overlapping emission bands in multiplexed applications. Here we demonstrate the ability of upconversion nanoparticles (UCNPs) to overcome issues associated with commonly used imaging techniques.

Upconversion Nanoparticles

Important properties of upconversion nanoparticles:



- Core made of rare earth elements
- 50 nm in size
- Attractive for bioimaging because of the anti-Stoke's effect properties

Main advantages over IHC and IF:

- Possibility to combine with a counterstain on the same tissue section
- Quantification is possible
- Potential for multiplexing due to very narrow emission spectrum
- No autofluorescence
- Very stable, no photobleaching

How it works

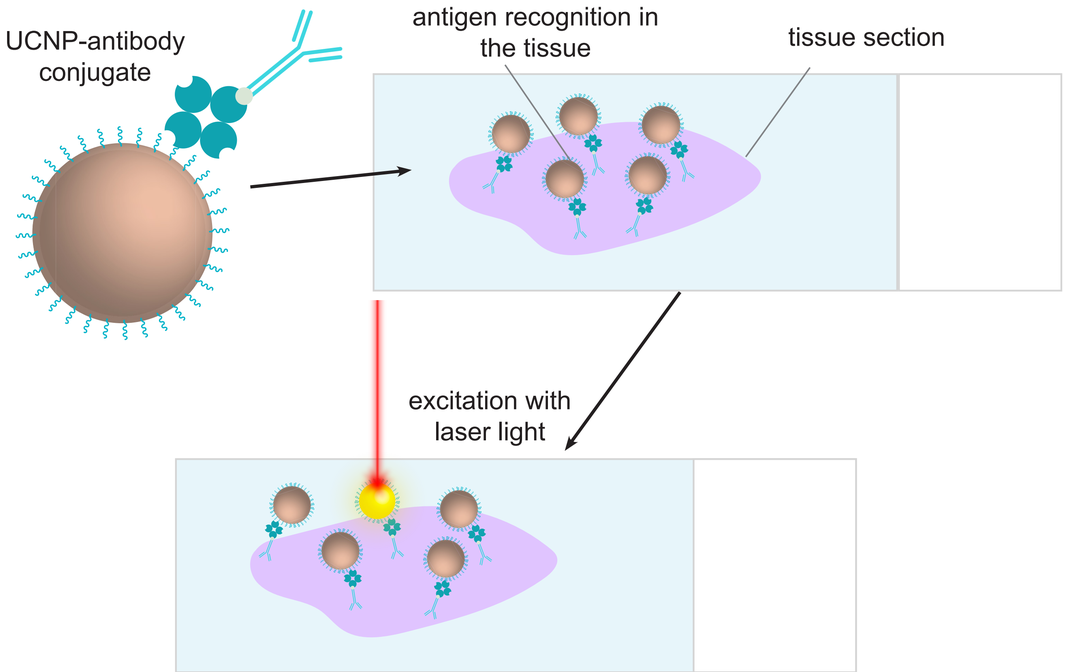


Figure 1. Staining workflow. Standard IHC workflow can be used with UCNPs. UCNP-antibody conjugates are formed and used to visualise antigens detected with standard primary antibodies. Fluorescent signal is obtained via UCNP excitation with a laser.

Our Solution

SCIZYS S1

SCIZYS Erbium Kit

Figure 2. Our product line. We offer an automated slide scanner capable of brightfield and fluorescent imaging. Our offer will contain a staining kit based on upconversion nanoparticles. The workflow is essentially the same as for standard IHC and an autostainer can be used.

Imaging

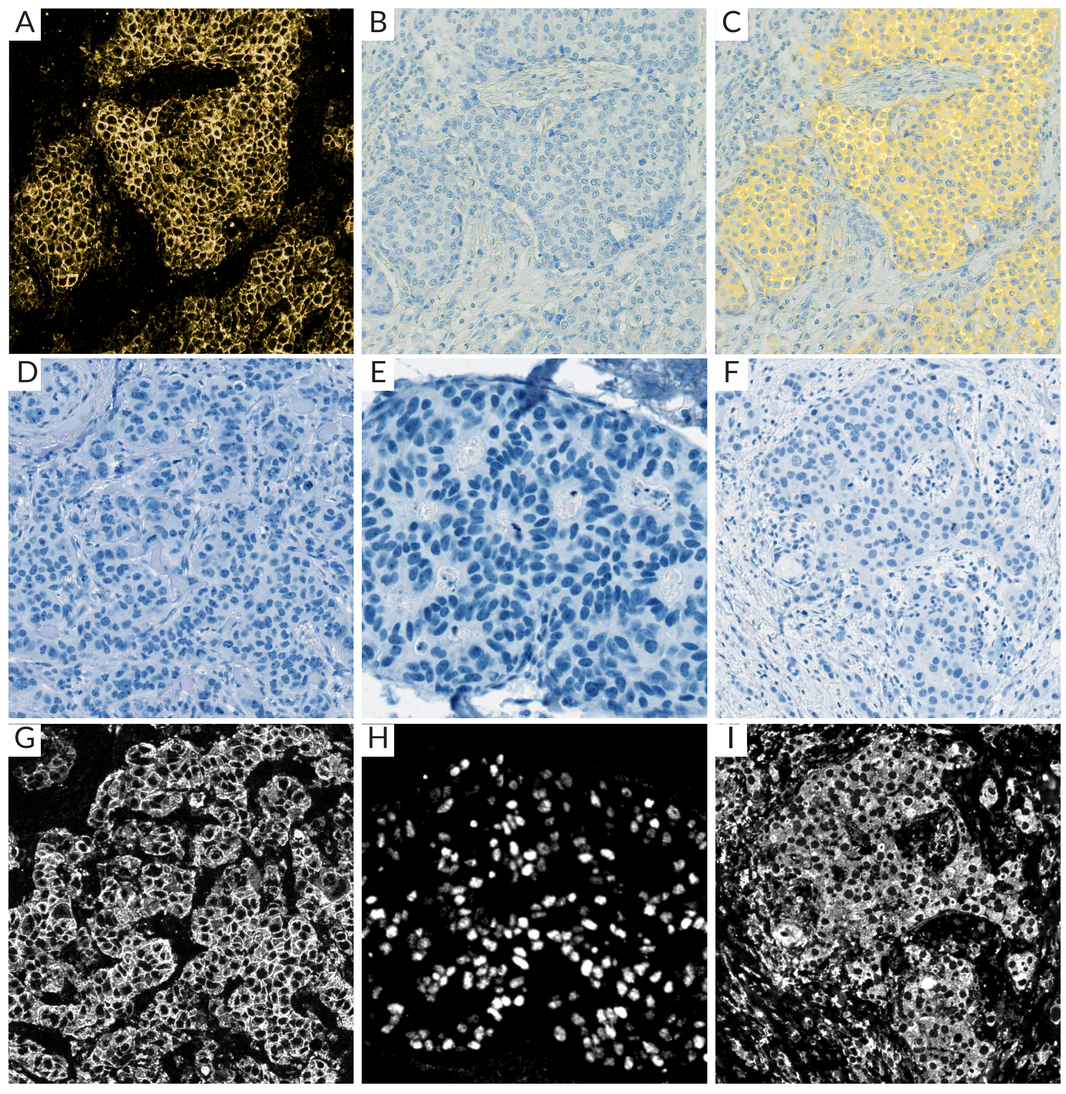


Figure 3. Examples of tissues and cells imaged with UCNP as the reporter. All images show FFPE human breast cancer tissue. In A-C, samples were labelled for HER2 and HTX. UCNP signal (A) or HTX (B) can be visualised alone, or in combination (C). D-F shows breast cancer tissue stained for HTX and corresponding tissue (G) stained for HER2 (3+), PR (H) and tubulin (I) respectively labeled with UCNP.

Conclusions

Staining solutions and a novel device developed by us give hope for more accurate diagnosis by keeping the advantage of H&E staining and combining it, in one image, with the luminescent data, ideal for generating ground truth for machine learning algorithms.

Mårtenstorget 5, SE-223 51 Lund, Sweden www.lumito.se +46 72 572 13 17 kk@lumito.se