Table 2: Novel Technologies

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Scope:

Capillary electrophoresis has been established in the 1980s and has grown since then regarding technological development and regarding fields of application. The implementation of CE as novel technology as such but also the combination of CE with other progressing technologies that directly and indirectly influence performance, information generation, data quality, and sensitivity, to name a few, were important steps on the way to establish CE as sound separation technique on the one hand and to open new fields of application for the changing and challenging environment in the (bio-)pharmaceutical industry. This development is ongoing. Key elements are:

- Instrumentation (e.g. platforms, chip technology)
- Automation (e.g. sample preparation and handling)
- Detection in general and hyphenation e.g. to mass spec
- Data engineering and data integrity
- Capillary technology, e.g. inner wall coating
- Chemistry

Questions for Discussion:

1. How is novel CE technology assessed and implemented in industry?
2. Cutting edge technology vs. robust methods – a contradiction?
3. Chip technology, multiplexing, and robotics – how important is throughput in QC?
4. Revival of the forgotten – known separation applications reactivated for the future?
5. Ease of implementation – what could support faster implementation in QC environment?

Discussion Notes:

1) How is novel CE technology assessed and implemented in industry?

Currently, PA800 is the gold standard for CE-SDS method across the industry, however, the throughput is relatively lower compared to Chip-based CE-SDS method due to long analysis time per sample. Chip based CE instruments have the advantage of easy to use and faster data analysis however sometimes scarify from resolution and reproducibility.

Higher throughput provides faster turnaround time specially valued for DOE experiment and large amount of samples/formulation screen. To best implement CE technology in industry, ideally, the instruments with following features should be considered:

- Easy to use with good resolution: potential QC friendly
- Transferrable
- Higher throughput or parallel process: more sample per unit time
- Data analysis: straight forward and automated for batch data process
- Automated sample preparation will improve the throughput as well

2) Cutting edge technology vs. robust methods – a contradiction?

Not necessarily exclusive from one to the other. CE technology has been around for decades and CE-SDS method as a widely accepted assay being commercialized and used for Biopharma industry for over 20 years, can be count as robust method, CE-MS, on the other hand, can count as a cutting-edge technology. Are we contradictory to ourselves by doing cutting edge technologies? No. Many years ago, MS only has TOF, nowadays, almost every lab has Orbitrap and other advanced mass spectrometers such as Lumos. Similarly, CE-SDS was the cutting-edge technology before, with the efforts from all the parties including vendors, users, with guidelines from regulatory agencies, it became a robust method although there is still room to improve.

CE combined with MS provide additional information of protein separation and identification at the same time, with the concern from regulatory about patient safety of the drug into the market, it would be good to gain as much information as possible at the early development stage. Therefore,

CE-MS is the future, revolutionary steps forward with new technologies, sensitivity and throughput is very critical. It needs some efforts to make it more robust and drive for more applicable to serve the analytical needs.

CE-MS can also provide complementary information regarding proteomics research.

3) Chip technology, multiplexing, and robotics – how important is throughput in QC?

Improved throughput will reduce the turnaround time in QC and reduced the cost. Robotics reduced labor-intensive work and avoided human error, especially with the pandemic the onsite time is limited, the robotic automated workflow become more demanding. Multiplexing will provide more information for molecule at all aspects.

There are two classes of automations:

- Smaller contained boxes do not have other functions beside prepare samples plates

- Fully automated liquid handling system such as Tecan and Hamilton, which can be customized all the way to the instrument, that's the trend of the instrument design

With those demands, we will need to work with vendors across industry to create new tools to a great extend to rely on.

4) Revival of the forgotten – known separation applications reactivated for the future?

Possibly. For example, there are still a lot of places using gels to characterize the molecules. With the new modalities, analytics need to be really inventive, maybe will bring back some of the technologies—even some known separation application might be able to reactivated for the future. Incorporate the applications by revisiting/revitalizing some of the methods to the newer modalities, such as chiral separation chromatography, multidimensional chromatography, etc. Develop new technologies to incorporated to existing technology.

5) Ease of implementation – what could support faster implementation in QC environment?

Methods have to be able to plug-in and play. Platform methods are preferred. Easy to use software and instrument are keys for fast transition time. High degree of automation can reduce human factor error. Technology has changing quickly, trainings are essential.