HFF-QCM immunosensor for fast and sensitive detection of DDT in honey

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SUMMARY

➤ The control of chemical residues is essential in honey's marketing to ensure **consumer safety**.

➤ Equipments available in the market reach the required limit of detection (LOD) (e.g **Liquid Cromatography -HPLC**) but are not suitable for in-situ implantation in honey packaging industry. The reasons are:
  o **Require highly qualified staff**
  o **High cost**
  o **Time-consuming**

➤ Other approaches available in the market, although faster and without the need of qualified staff, do not reach the required LODs.

➤ **Piezoelectric immunosensors** based on High Fundamental Frequency Quartz Crystal Microbalance (HFF-QCM) combined with an antigen-antibody recognition process, are alternative or complementary technologies suitable for chemical residues control in food.

➤ The analytical performance of AWS A20 and AWS F20 platforms (based on HFF-QCM technology), has been tested for the detection of pesticide residues (DDT) in honey.

➤ AWS platforms lead to the following **benefits:**
  o **Lower cost**
  o **Less sample/reagent consumption**
  o **Label-free, direct and real time transduction**

➤ DDT standard curves performed in laboratory buffer provided:
  o **Sensitivity (estimated as the I_{50} value): 0.62 µg/L**
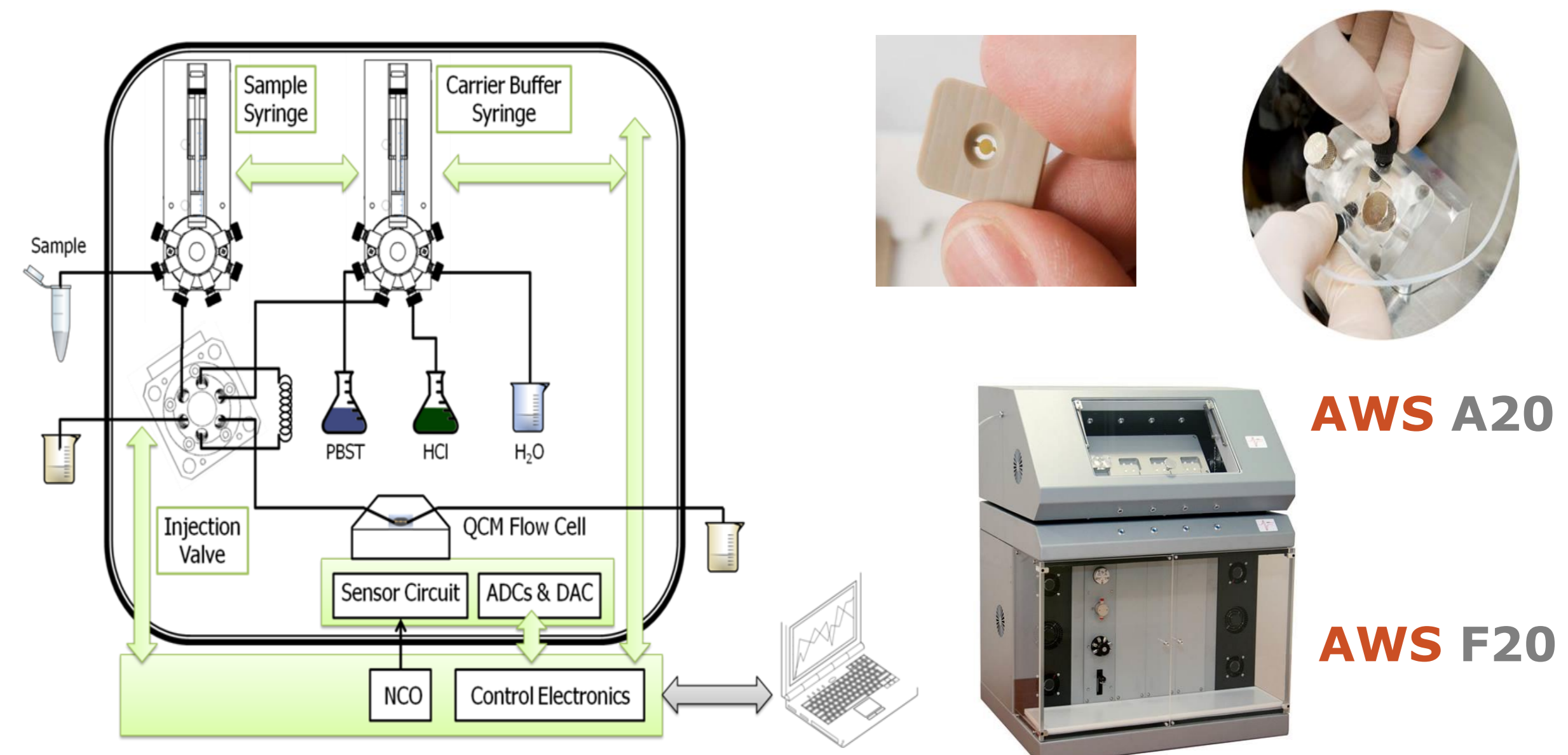 o **LOD in the 0.05 - 0.1 µg/L range.**

SENSING INTERFACE AND SIGNAL TRANSDUCTION STRATEGY

mSAM-functionalized electrode surface
Hapten Conjugate
Mab
Analyte
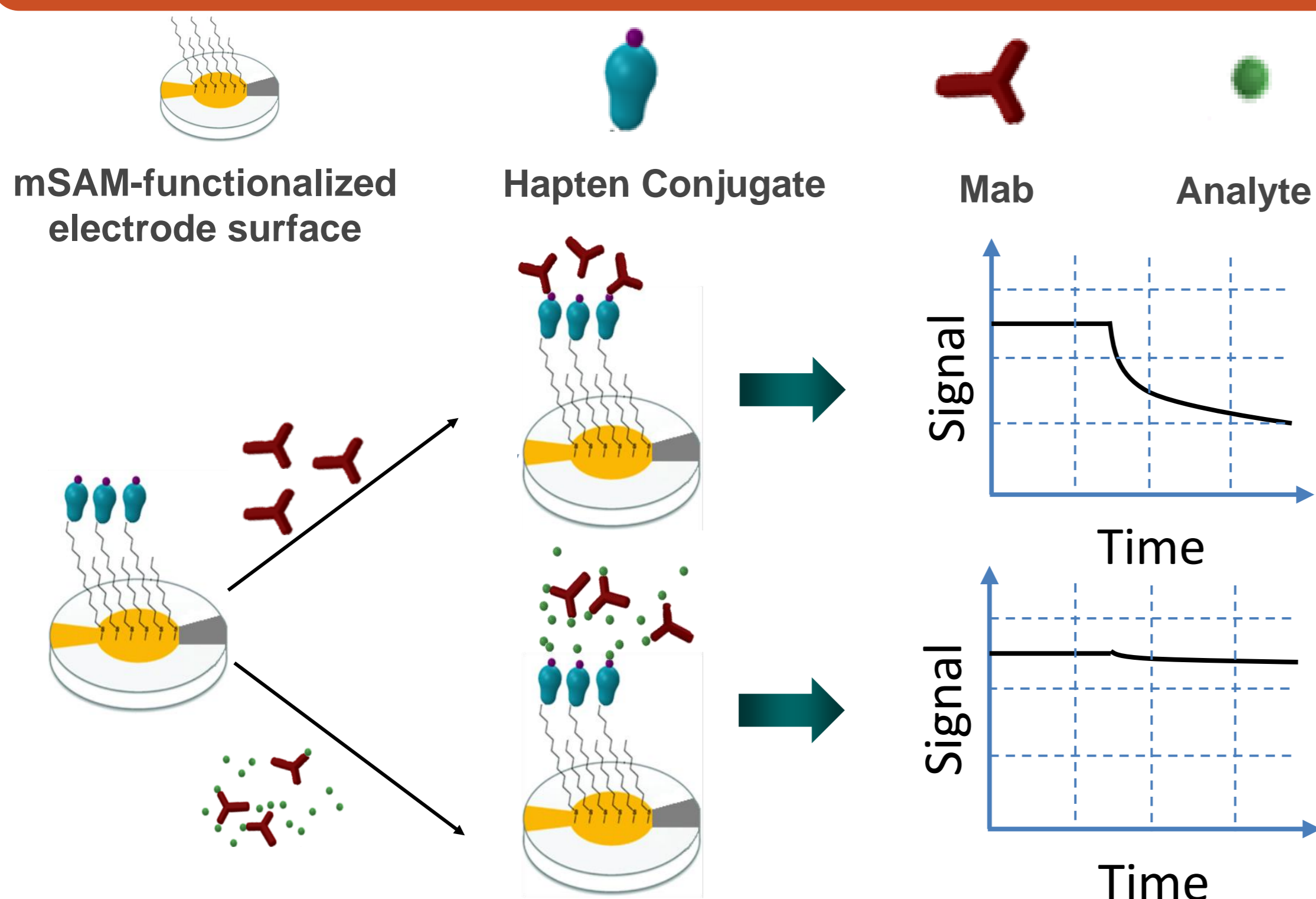
EXPERIMENTAL SETUP AND TEST PLATFORMS AWS A20 AND AWS F20

Scheme of AWS A20 and AWS F20 platforms

HFF-QCM sensor chip and flow cell assembly

AWS A20
AWS F20

RESULTS

HFF-QCM Standard Curve for DDT

o Concentration of immobilized **BSA-DDT5 conjugate: 10 µg/ml**

o Concentration of **LIB-DDT5.25 monoclonal antibody: 0.5 µg/ml**

o Inter-assay **regeneration: 0.1 M HCl**
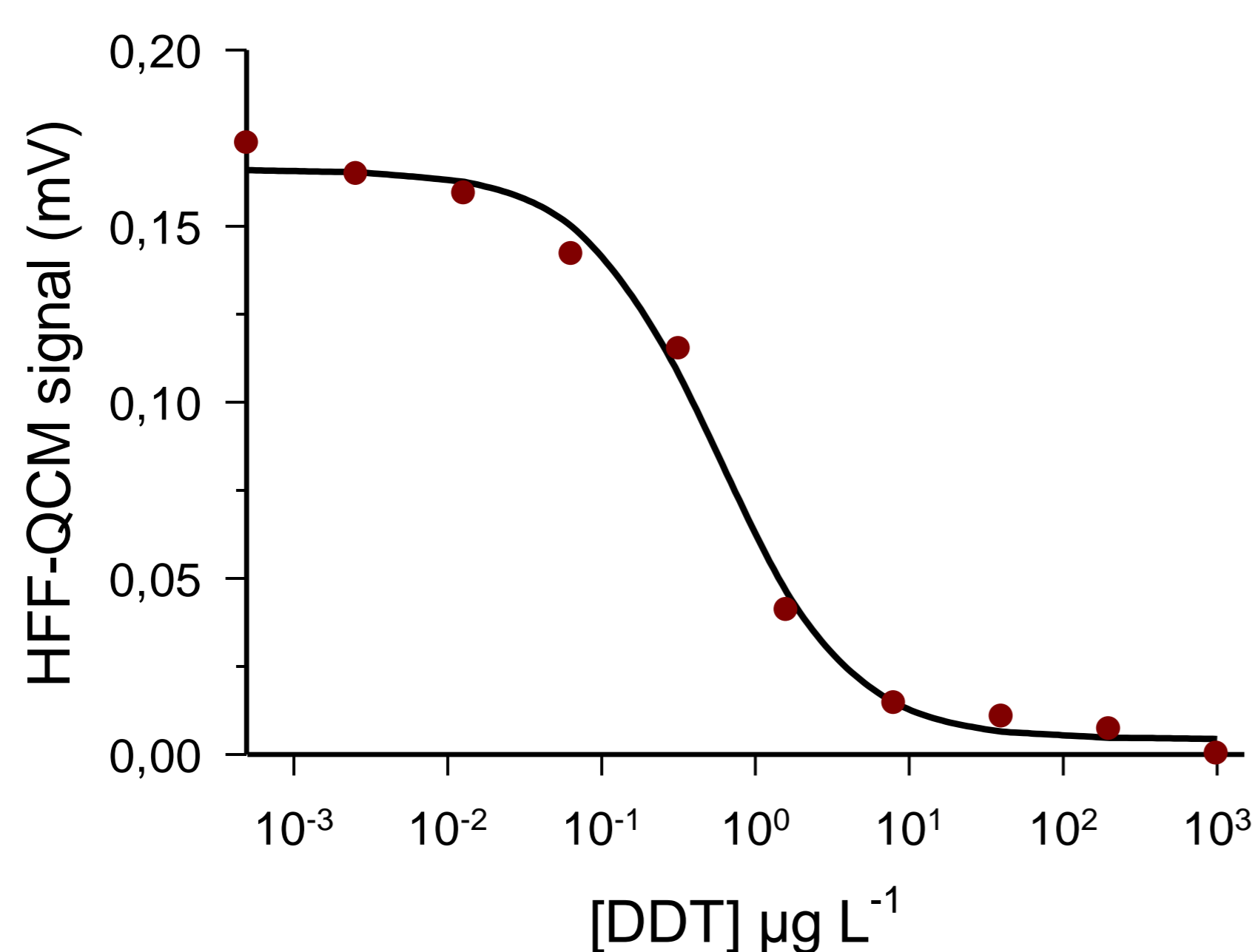
Analytical Parameters

Analytical performance of the **HFF-QCM immunosensor** for DDT as compared to previously developed **ELISA** and **SPR immunosensor**

Analytical parameters ($\mu g\ L^{-1}$)	HFF-QCM immunosensor	ELISA[1]	SPR immunosensor[2]
I_{50}	0.62	0.74	1.06
LOD	0.08	0.15	0.03
LOQ	0.16	0.22	0.11
WR	0.16 – 2.37	0.22 – 2.47	0.11 – 10.07

[1]Estimate from *Abad et al., 1997. J. Agric. Food Chem. 45, 3694-3702.*

[2] Mauriz et al., 2007. Biosens. Bioelectron. 22, 1410-1418.

REMARKS

➤ **A HFF-QCM immunosensor** for **DDT** insecticide has been developed.

➤ Efficient biosensing interfaces were achieved by covalent functionalization of the sensor gold electrodes with mixed alkane-thiol self-assembled monolayers (**mSAMs**).

➤ **High-sensitivity monoclonal antibodies** were used as the bio-recognition element of the target analyte in a competitive immunoassay format.

➤ The limits of detection (**LOD**) and quantification (**LOQ**) and the working range (**WR**) of the developed HFF-QCM immunosensor for DDT are in **the same order of magnitude** as those previously reported for **ELISA** and **SPR immunosensor**.

ACKNOWLEDGEMENT