

I. Motivation & Background

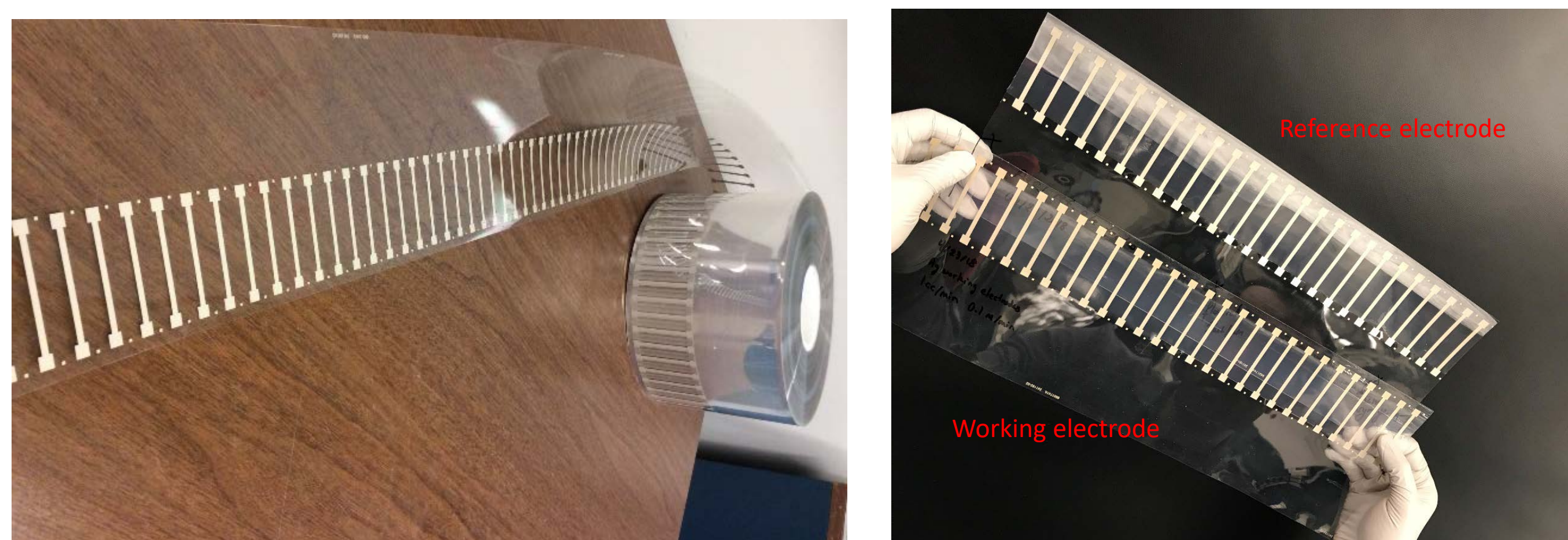
Accurate measurement:

- Real-time, in-field and non-destructive measurement
- Reduce operational expense
- Increase testing throughput

Nitrogen levels in soil:

- Nitrate level not fertilized or used for crops: 5-10 ppm (mg/kg).
- Nitrate levels for plants growth: 25-30 ppm.

II. Structure



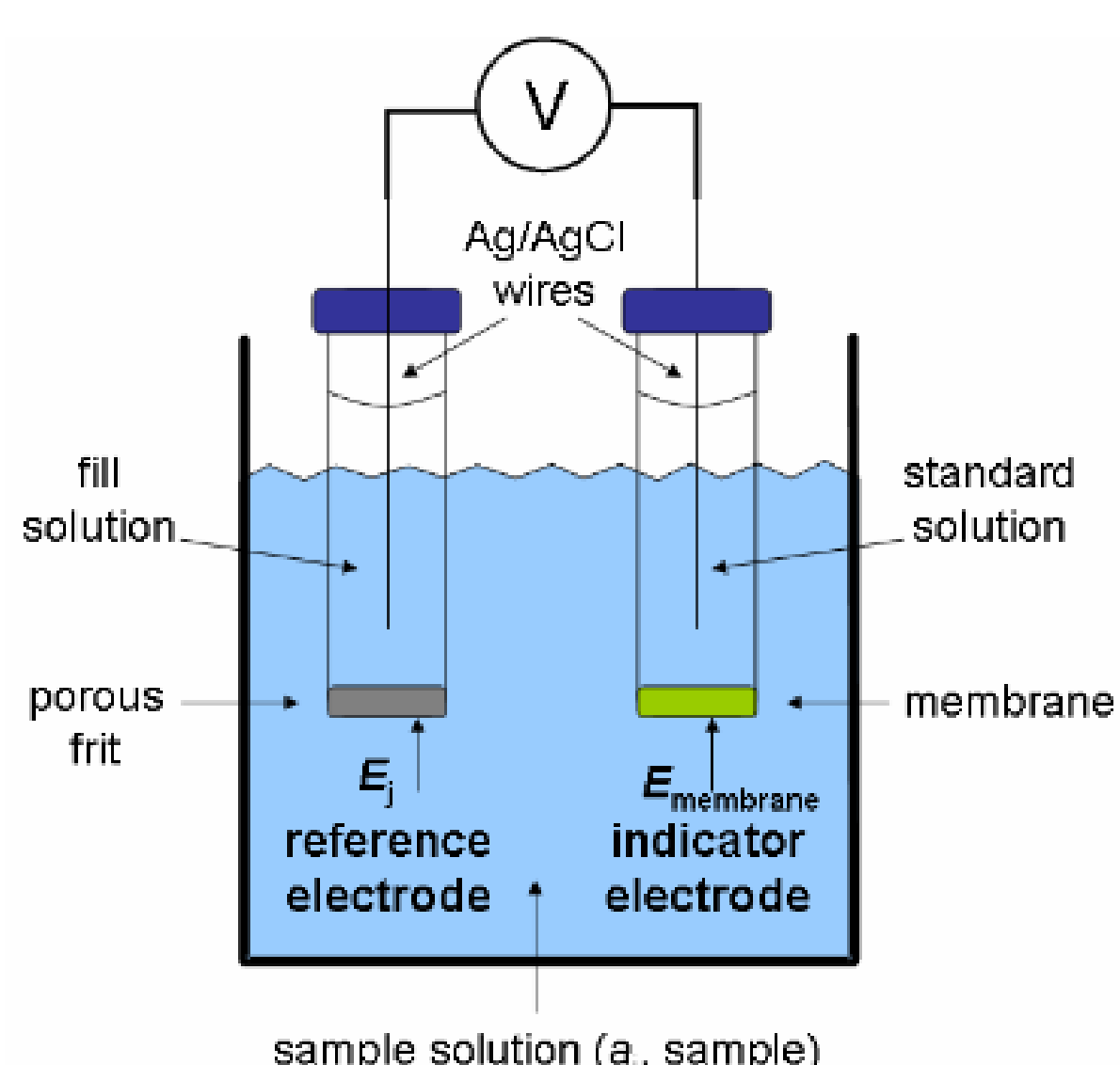
Substrate: Thermal treated PET

Conductive base: Silver (working electrode)
+ silver/silver chloride (reference electrode)

Nitrate selective membrane:

Dibutylphthalate + PVC + Tetraoctylammonium bromide

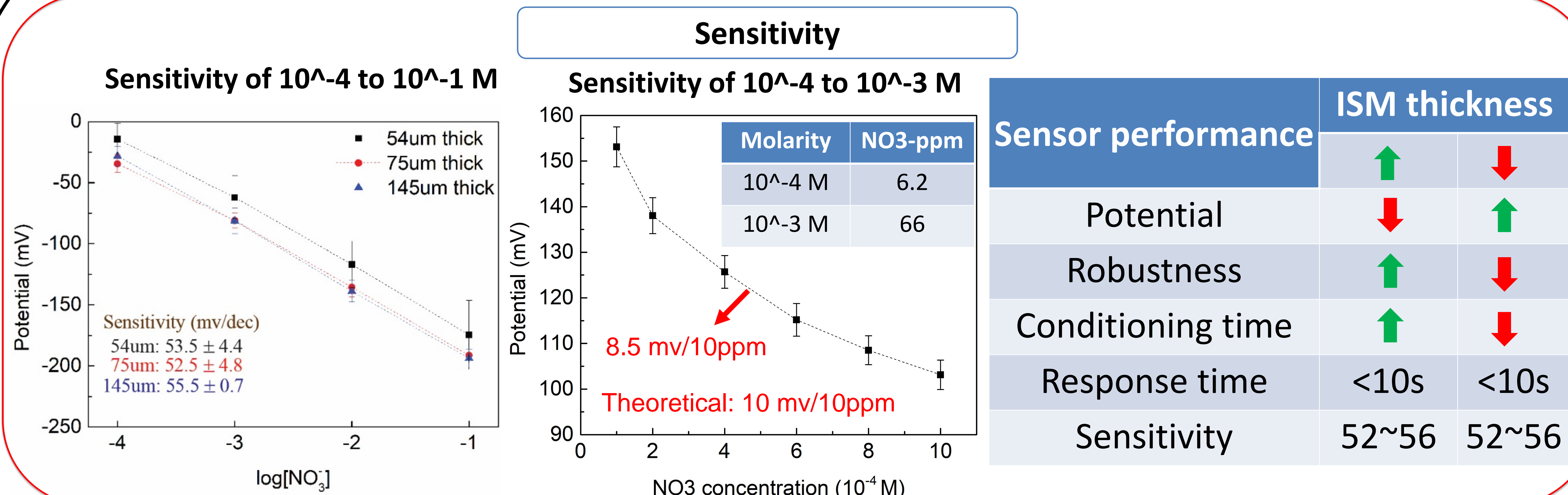
III. Potentiometric principle



Reference electrode: Providing stable reference electrochemical potential;

Working electrode: coated with ion selective membrane (ISM) to couple measured potential to nitrate concentration;
Theoretical value: 60mv/dec;

IV. Characterization



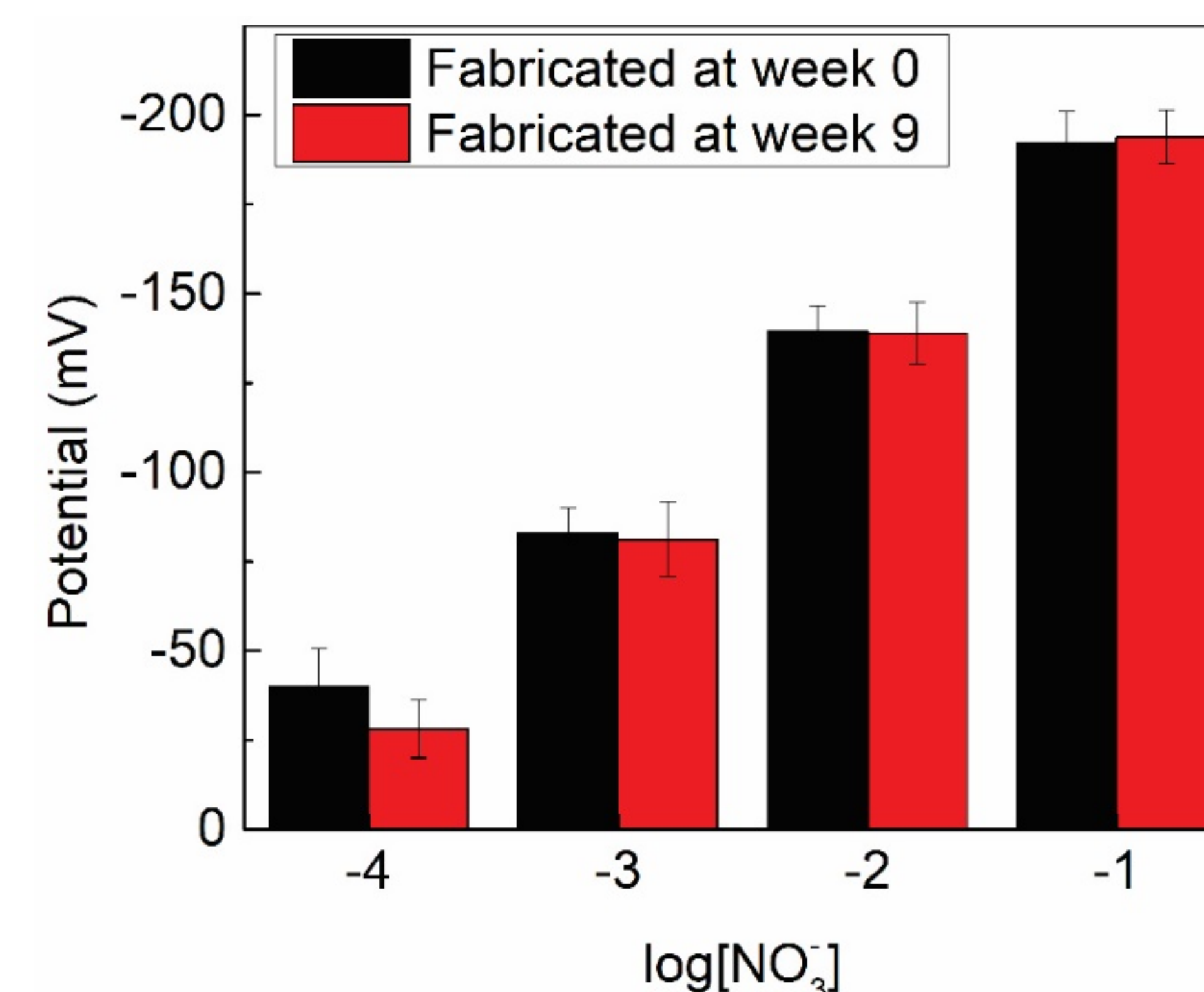
Stability

24 hours in 0.1M Nitrate solution

ISM thickness(um)	Drift (mv/hr)
54	0.48 ± 0.04
75	0.6 ± 0.1
145	0.53 ± 0.13

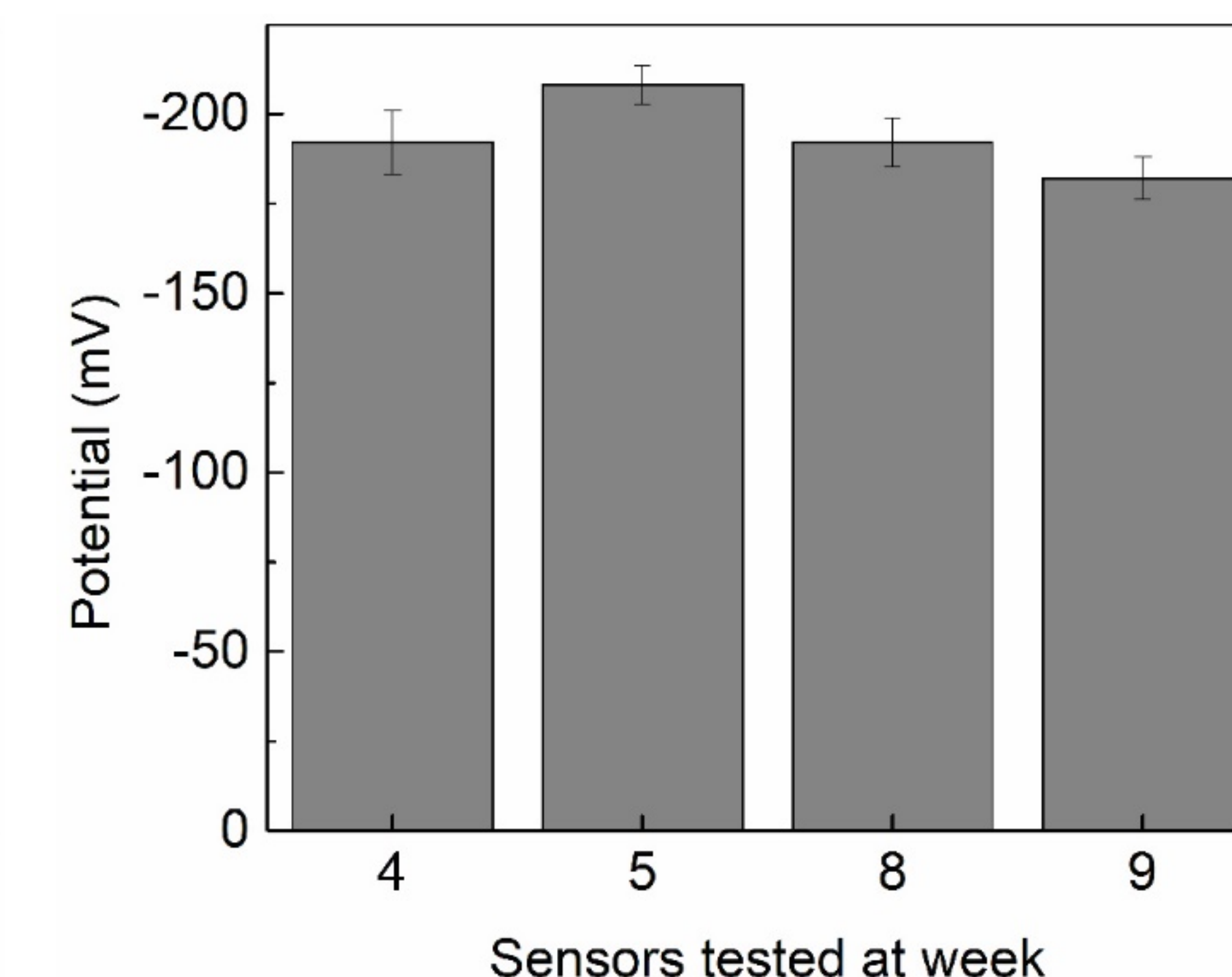
Reproducibility

Batch to batch reproducibility



Shelf-life

Total 35 sensors tested in 0.1M nitrate



IV. Conclusion

More than 300 sensors tested for standard solution characterization

- ~55 mv/dec sensitivity from 0.0001M to 0.1M nitrate solution;
- ~8.5 mv/10ppm sensitivity from 6 to 60 ppm (targeted nitrate level);
- ~0.5 mv/hr of long term stability;
- In batch repeatability (SD of <10mv);
- Highly batch to batch reproducibility (>90%);
- More than two months shelf-life;