

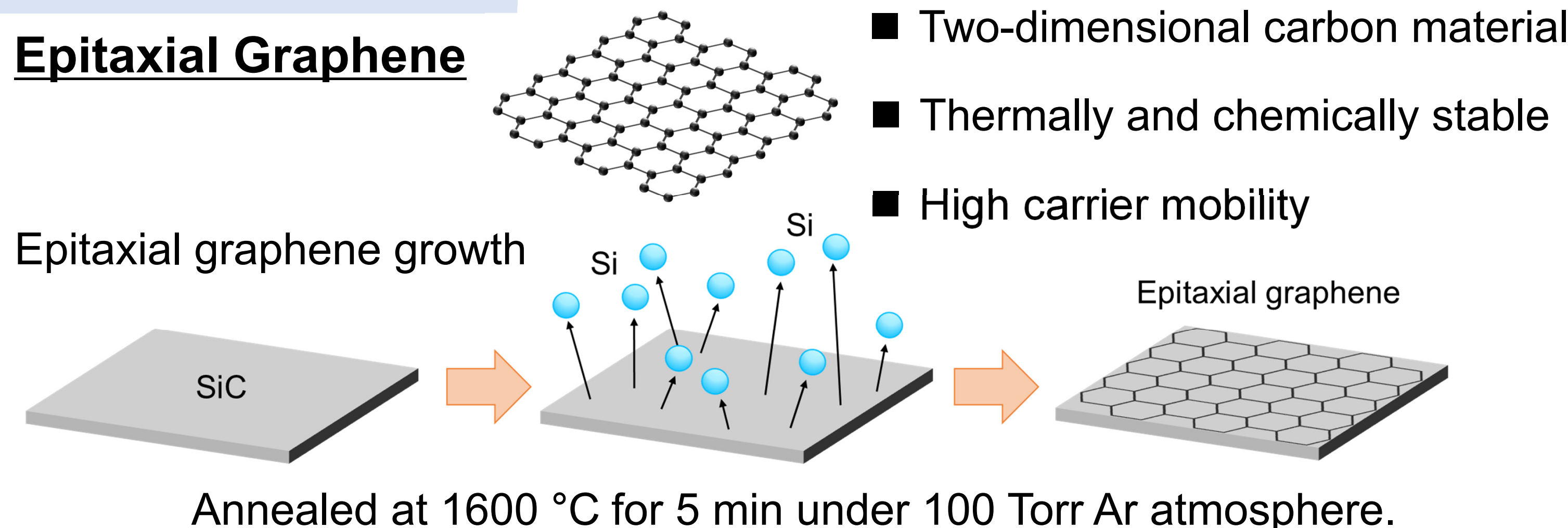
単結晶グラフェンを用いた遮蔽長外ターゲットが検出可能な バイオセンサ開発

大野 恭秀

徳島大学大学院社会産業理工学研究部理工学域電気電子系

Introduction

Epitaxial Graphene

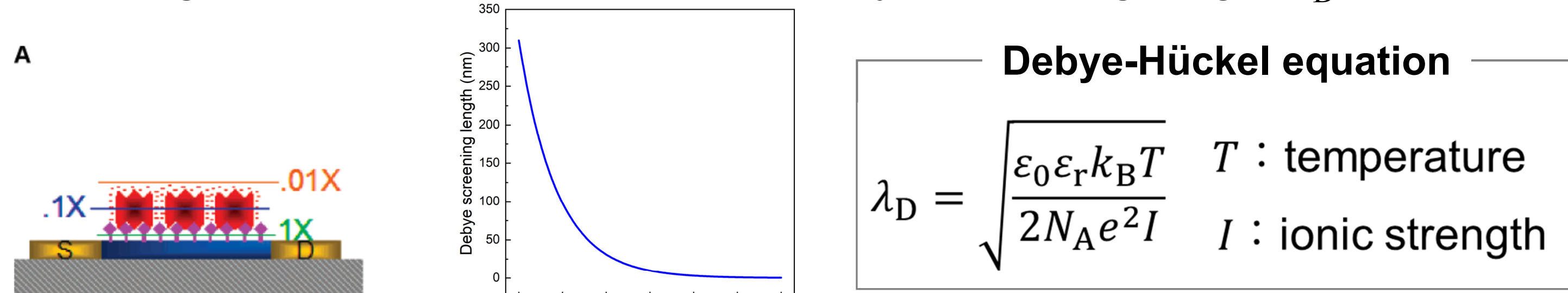


Single-crystal, large-area graphene is produced.

Debye screening length

Targets are detectable within the Debye screening length λ_D .

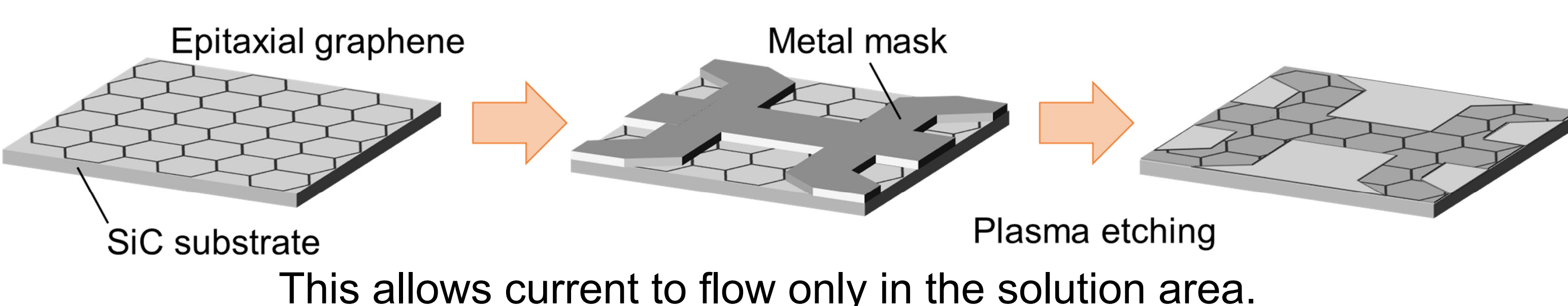
[1]



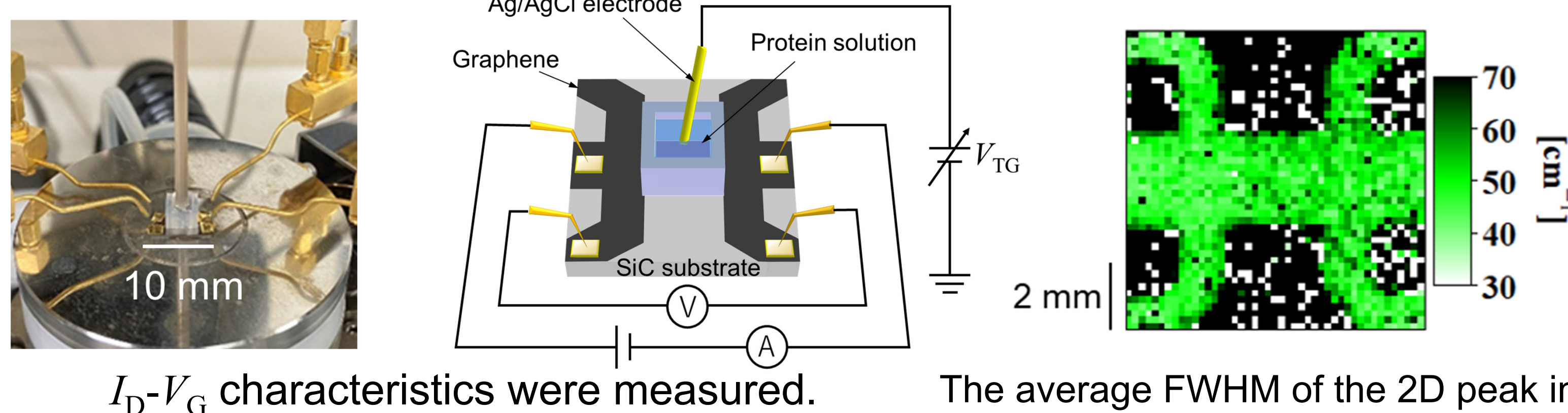
λ_D is approximately 1/10 of antibody length in biological fluids (1xPBS).

Experiments

6-terminal Hall bar processing

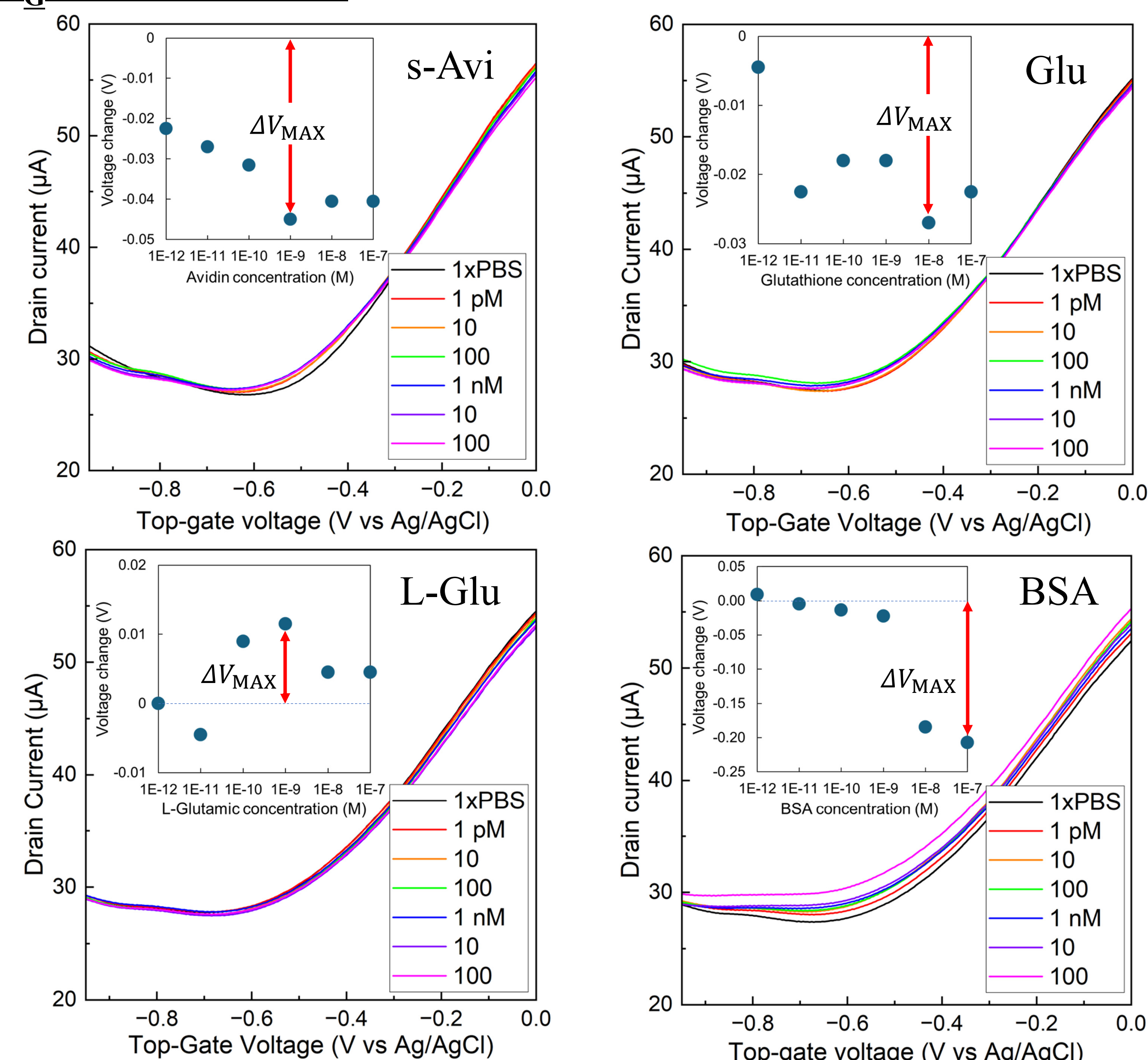


Graphene FET



Results and Discussion

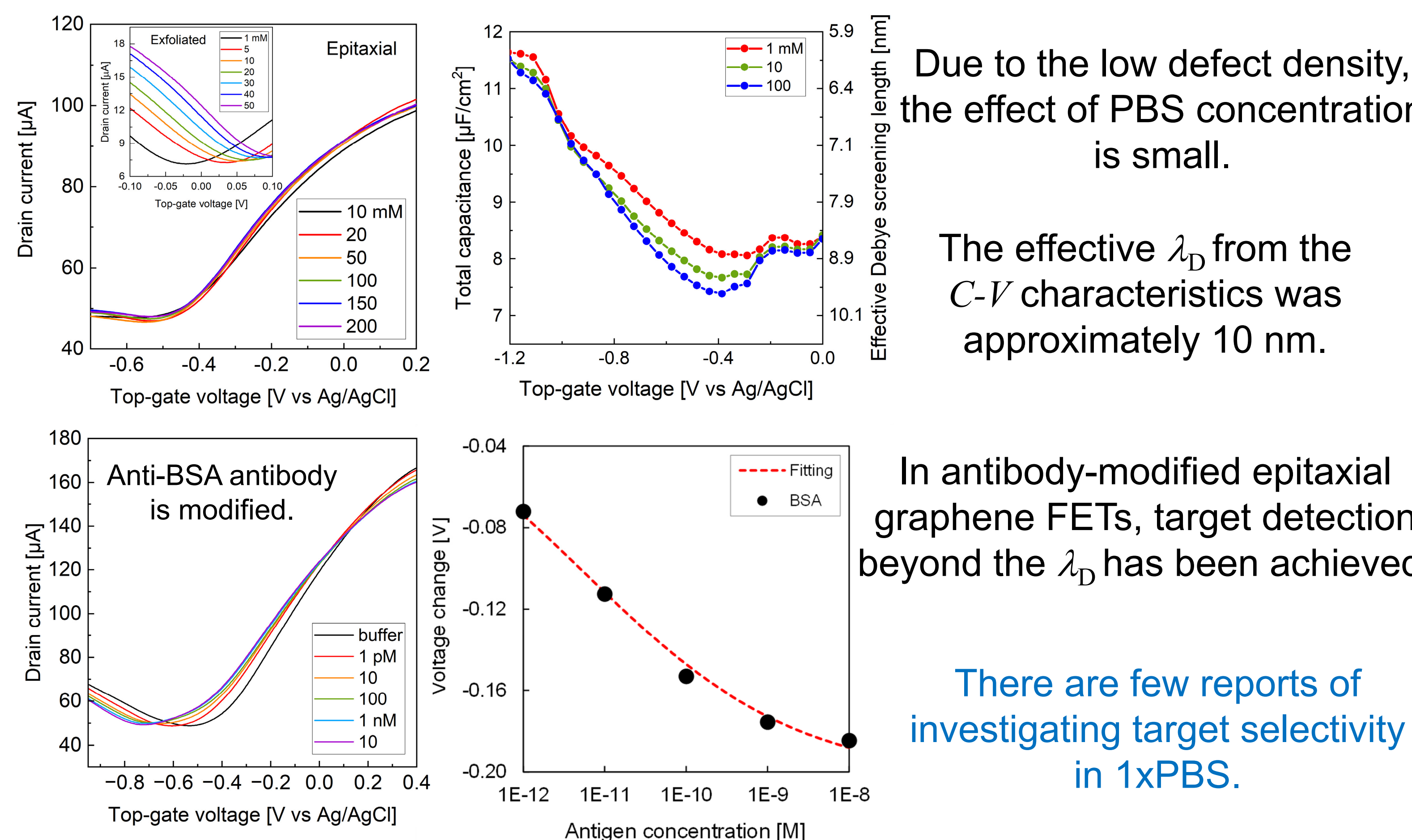
I_D-V_G characteristics



Summary

- I_D-V_G characteristics of single-crystal epitaxial graphene are independent of buffer concentrations.
- Our simple device overcame the Debye screening length limitation and detected targets in physiological salt concentrations (1xPBS).
- The target selectivity of the antibody-modified epitaxial graphene FET was confirmed.

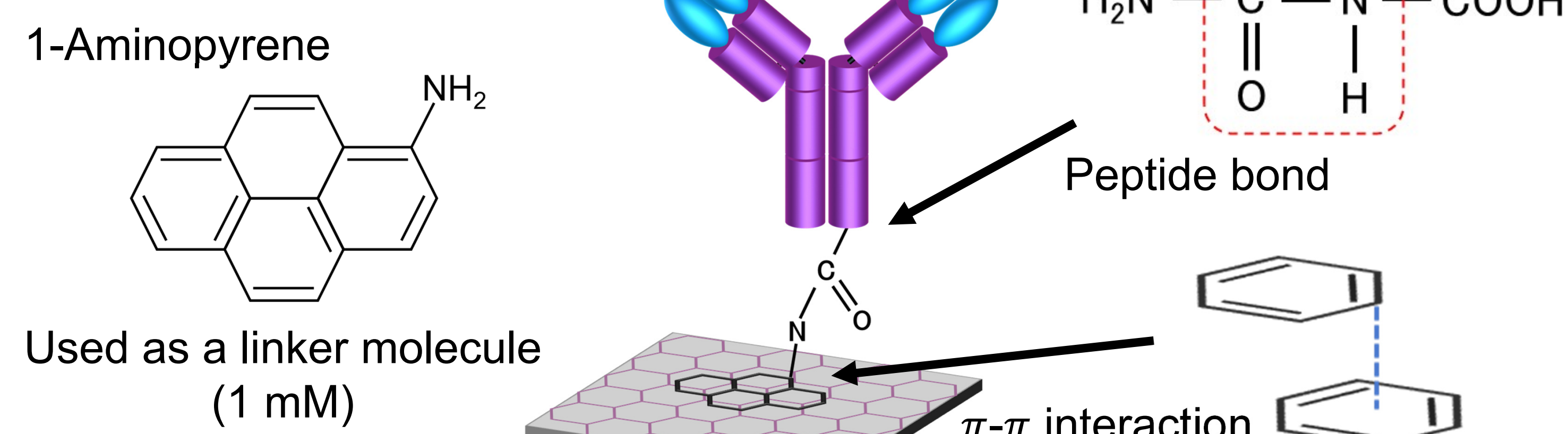
Previous work [2]



Target selectivity in antibody-modified epitaxial graphene was investigated.

[2] K. Murayama et al., Surf. Interfaces, **54**, 105279 (2024).

Antibody modification

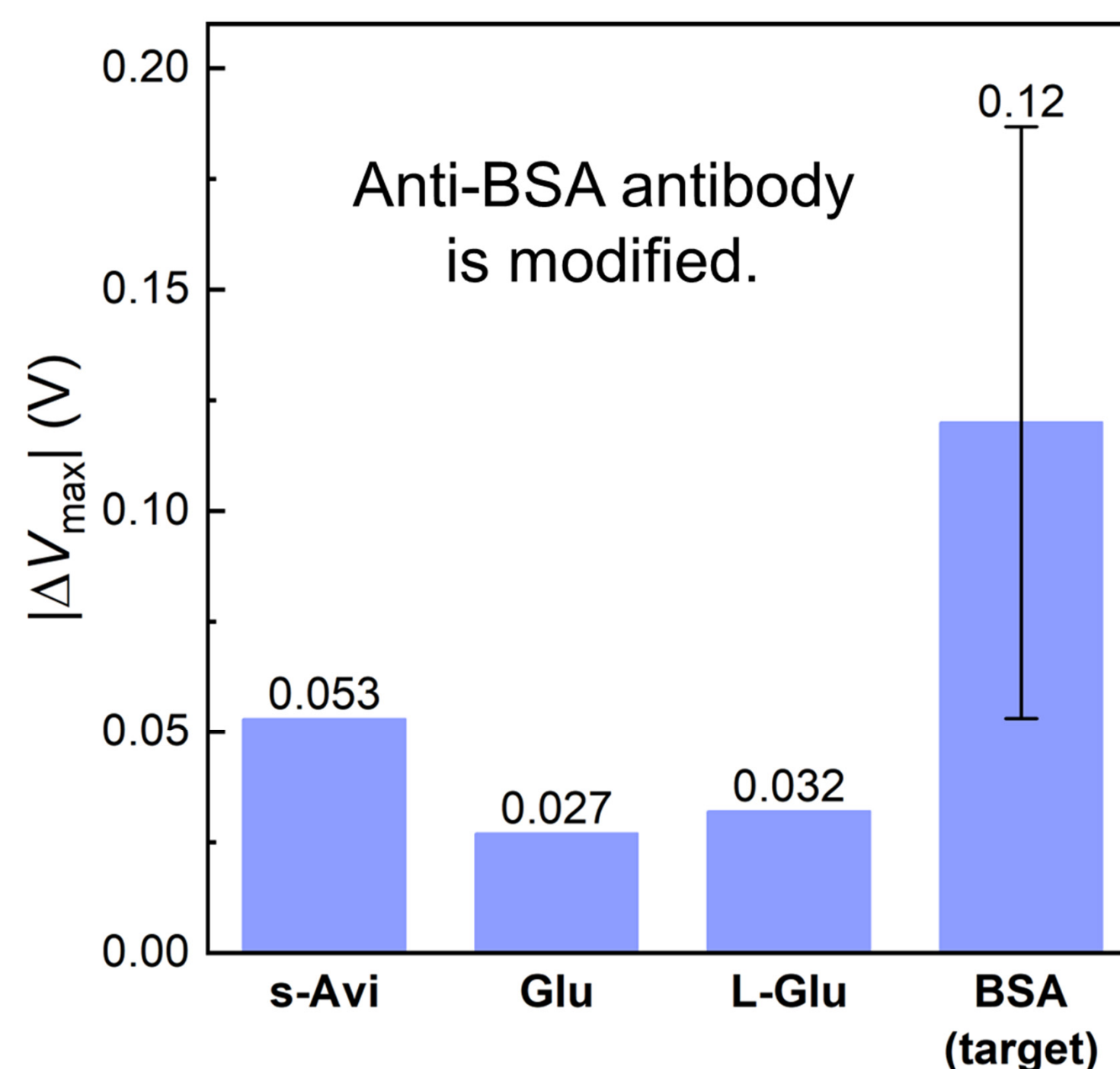
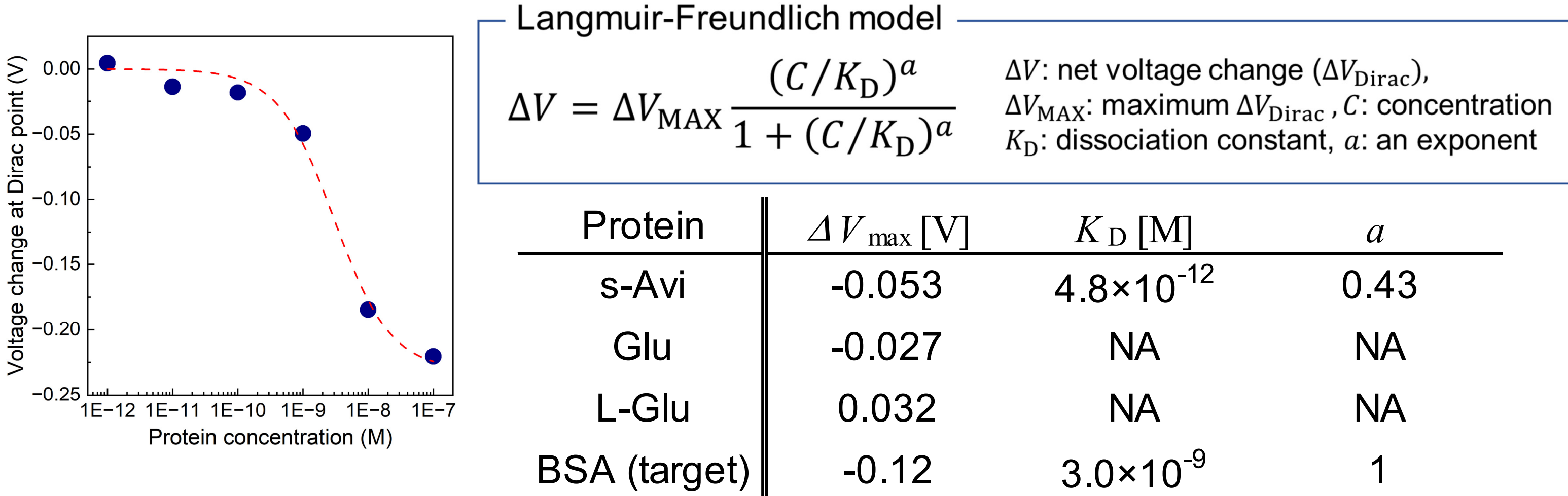


Protein solution

Protein	Prepared concentrations ranging from 1 pM to 100 nM
Streptavidin (s-Avi)	
Glutathione peroxidase (Glu)	
L-glutamic dehydrogenase (L-Glu)	
Bovine serum albumin (BSA, <u>target</u>)	

1x Phosphate-buffered saline (1xPBS) is used as the solvent.

Specific target detection



By K_D , physisorption was confirmed for non-target introduction and antigen-antibody reaction for target introduction [3].

ΔV_{MAX} at target was 2.3–4.4 times higher than that of other proteins.

Only BSA exhibited antigen-antibody reactions.

In antibody-modified epitaxial graphene FETs, target selectivity was confirmed beyond the Debye screening length in physiological salt concentrations.

[3] H. Nakai et al., J. Appl. Phys. **130**, 074502 (2021).