

# GP IDeA-CTR PILOT GRANT: Peripheral Nerve Regeneration with Novel Graphene Nerve Guidance Conduit (NGC)

Jung Yul Lim<sup>1</sup> (PI), Alexander Sinitskii<sup>2</sup> (Co-PI)

<sup>1</sup>Dept. of Mechanical & Materials Engineering, <sup>2</sup>Dept. of Chemistry, University of Nebraska-Lincoln



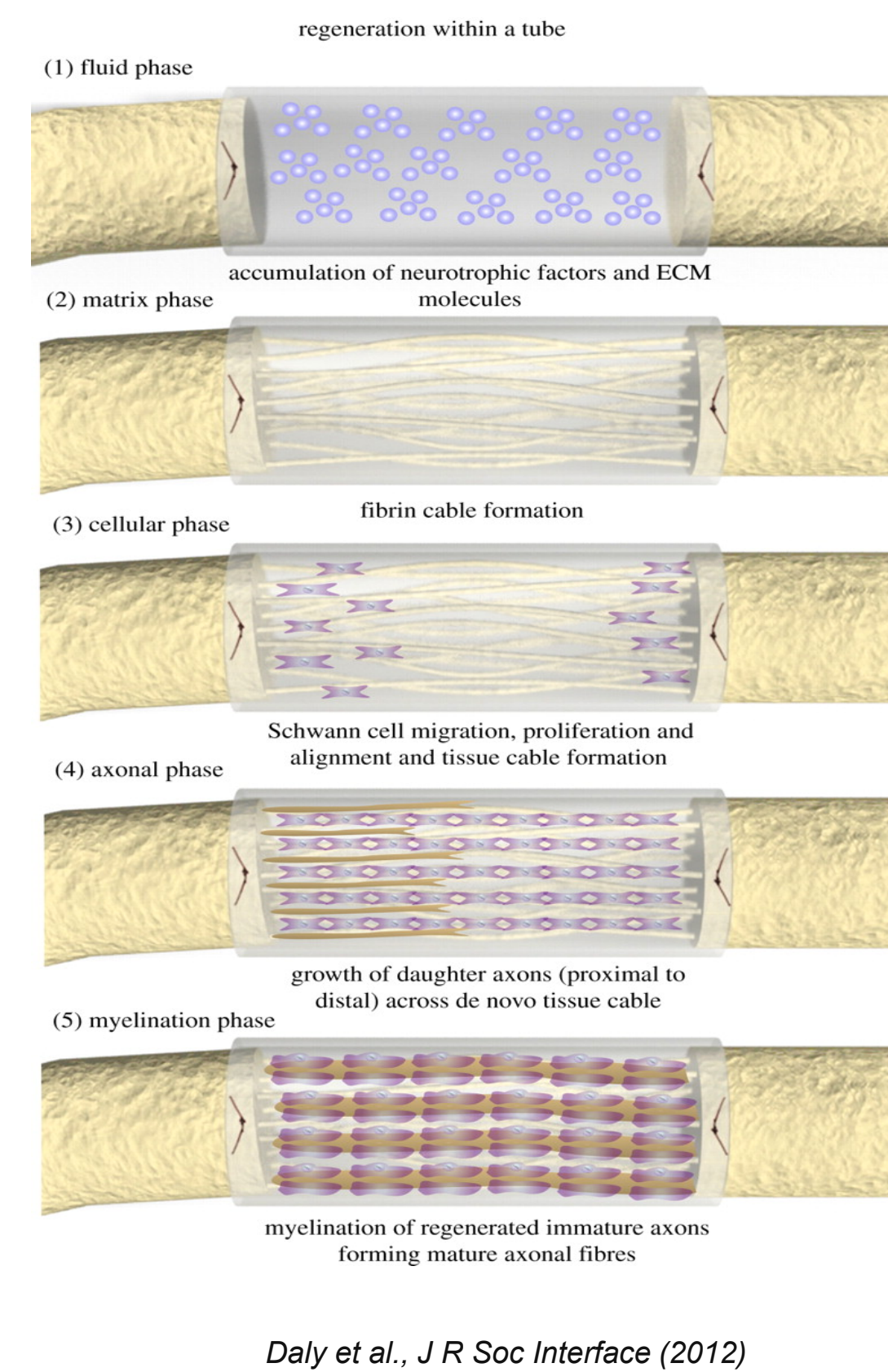
## INTRODUCTION

### Peripheral Nerve Regeneration with Synthetic Nerve Guidance Conduit (NGC)

**Rationale:** In treating peripheral nerve injury, autograft transplantation has disadvantages including limited supply, donor site morbidity, mismatch in size and character, and neuroma formation and scarring. The allograft also has potential issues of immune disease, infection, and tumor formation. While synthetic NGCs have shown some success, current man-made NGCs do not match with the regenerative capability of autograft nerves, frequently displaying very poor and incomplete functional peripheral nerve repair. It is thus in urgent need to develop NGCs having superior peripheral nerve regeneration capability.

**Innovation:** Exploiting potential capacity of graphene material to trigger/support neural regeneration.

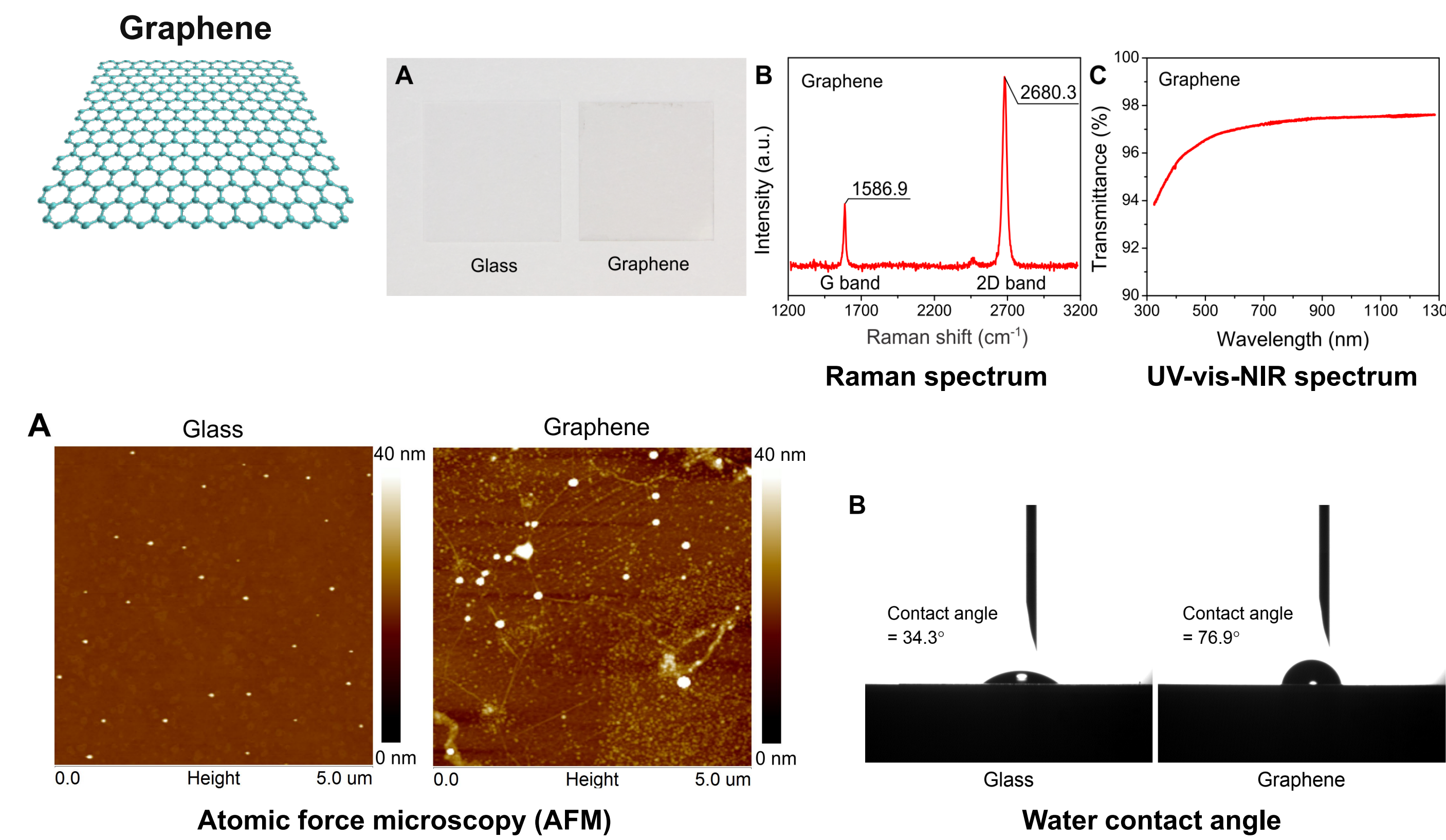
**Goal:** Considering that initial Schwann cell growth and alignment is critically required for peripheral nerve regeneration (fig. right), we first explore the graphene control of Schwann cell behavior.



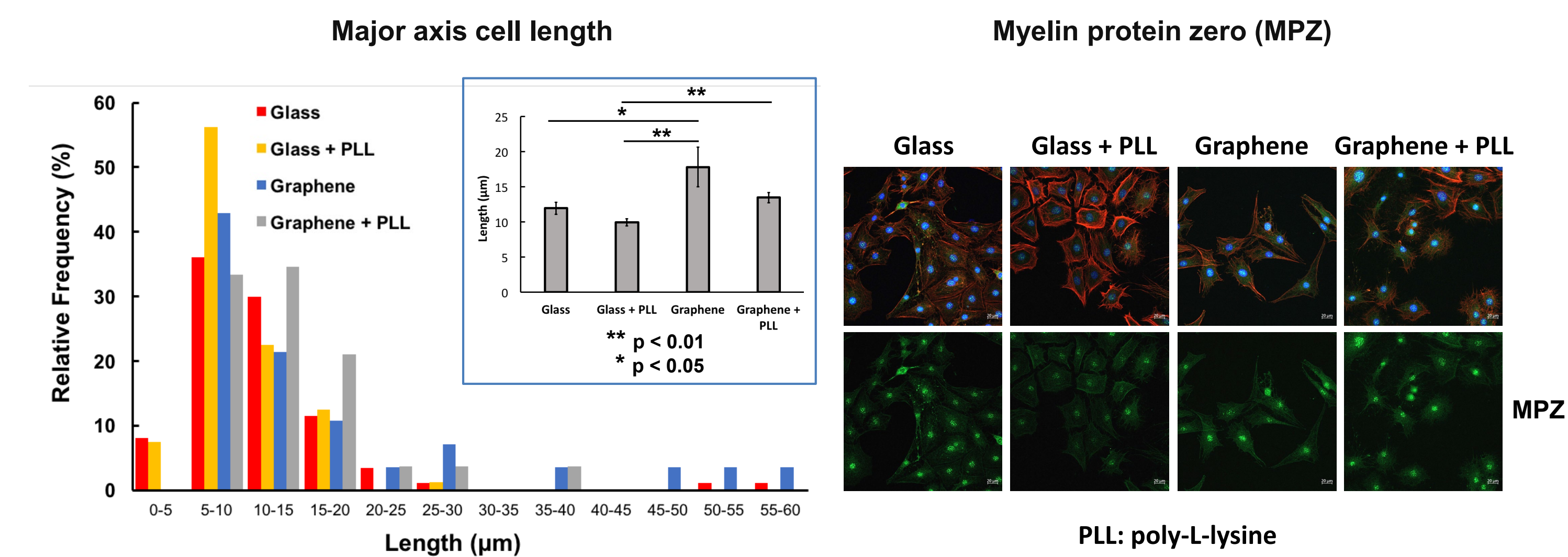
Daly et al., J R Soc Interface (2012)

## RESULTS

### Graphene Substrate Fabrication and Characterization



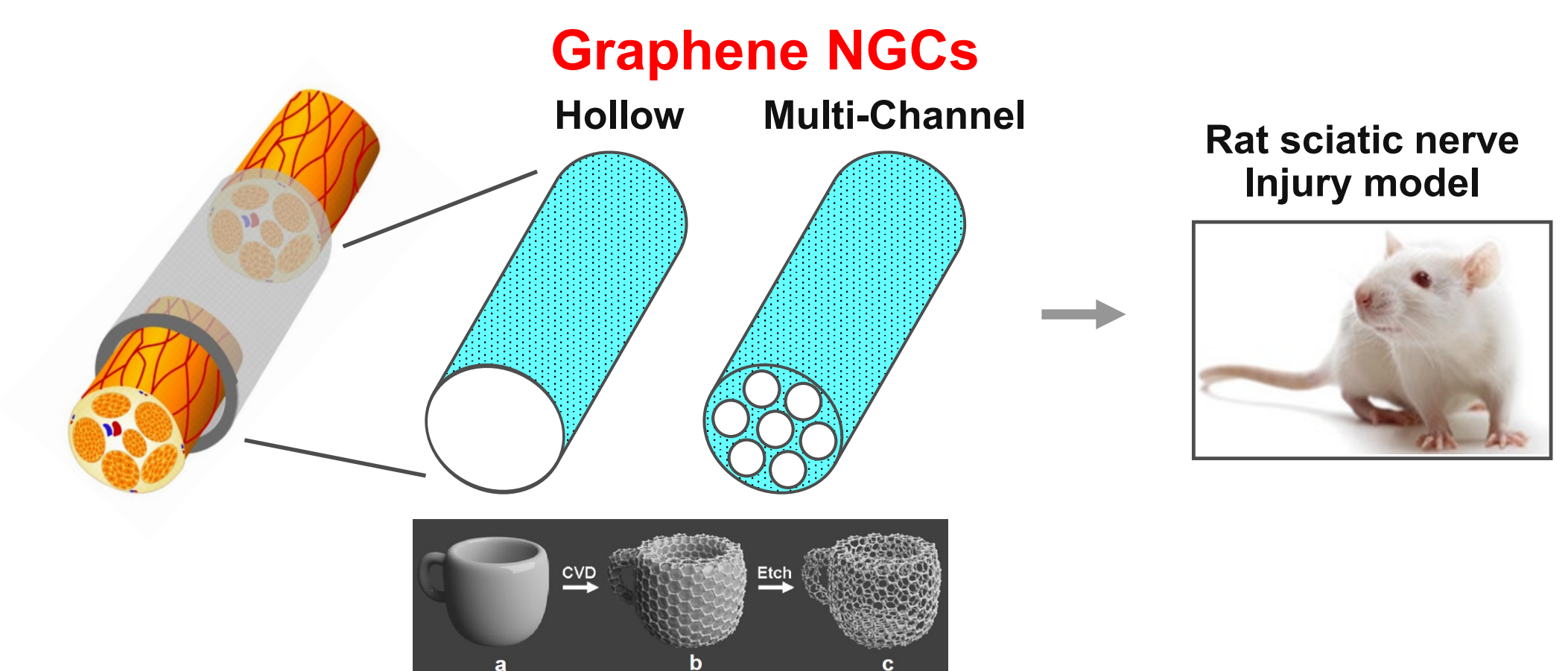
## RESULTS (CONT.)



## CONCLUSIONS/FUTURE DIRECTION

**Conclusions:** Schwann cells cultured on graphene substrate showed morphological changes, e.g., increased aspect ratio and major axis length but decreased cell area, relative to those on glass. This suggests the potential benefit of graphene material to induce required Schwann cell alignment within nerve guidance conduit.

**Future Direction:** (1) Mechanism study on graphene control of Schwann cells including FAK; (2) Schwann cell-axonal co-culture model to test axonal guidance; (3) Graphene NGCs for testing peripheral nerve regeneration with rat sciatic nerve injury model.



## OBJECTIVE

### Test Graphene Substrate Culture Control of Schwann Cell Adhesion, Alignment, and Functional Activity

**Scientific Premise:** Schwann cell ingrowth and alignment within synthetic NGC is a crucial guidance step for later axonal growth and myelination for peripheral nerve regeneration.

**Specific Aim:** Examine the effects of graphene substrate culture on the growth, alignment, and differentiation of Schwann cells.

**Hypothesis:** Schwann cell functional activity may be enhanced on graphene substrate culture via focal adhesion kinase (FAK) signaling.

## METHODS

**Schwann Cell Model:** Rat S16 (ATCC CRL-2941).

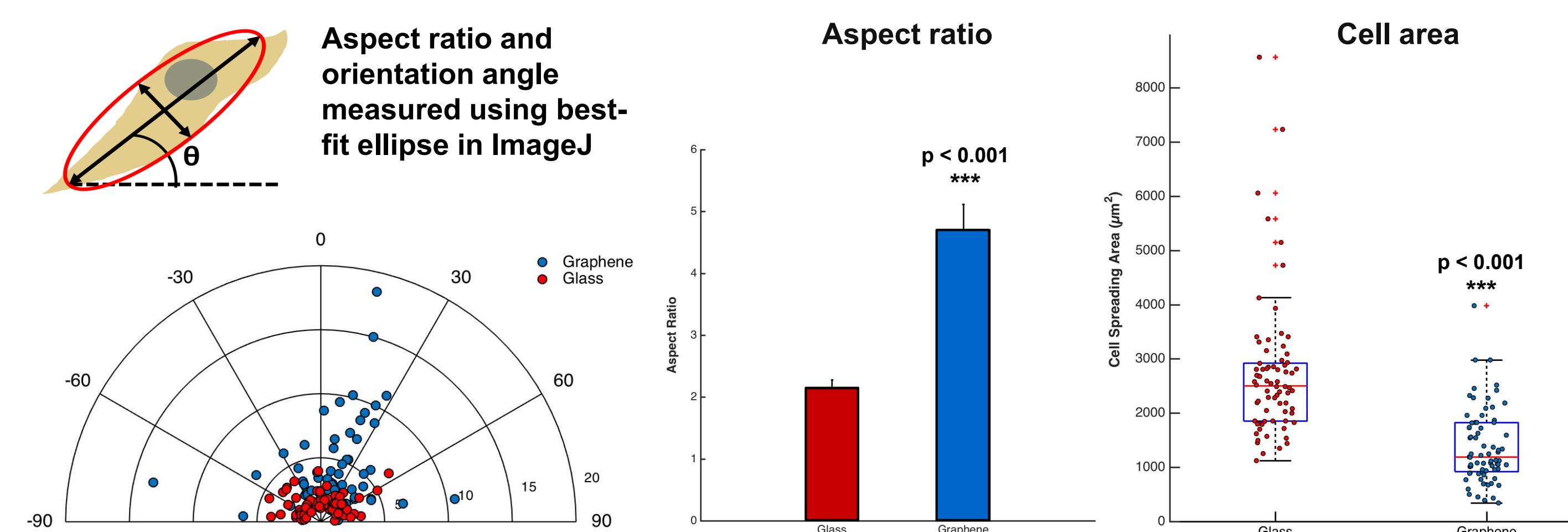
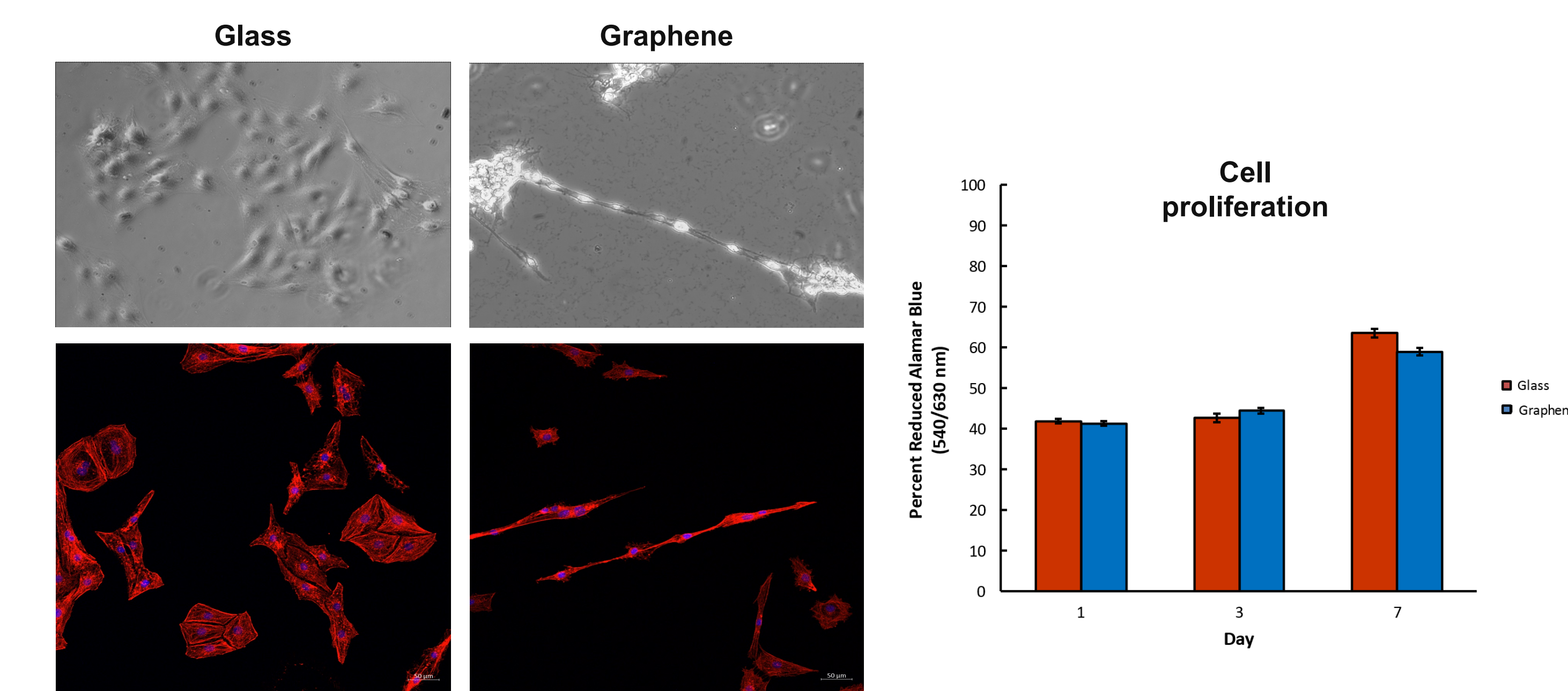
**Graphene Monolayer Film:** Chemical vapor deposition (CVD) followed by wet transfer on basal glass substrate.

**Cell Morphology:** Cell spreading area, aspect ratio, orientation angle, and major axis length. Fluorescent images are analyzed by ImageJ. A total of n > 100 cells were analyzed for each case.

**Cell Proliferation:** Alamar blue proliferation assay.

**Schwann Cell Phenotype:** Fluorescent imaging of Schwann cell marker (myelin protein 0, MPZ) and others (MBP, GFAP, GAP43, Dhh, etc.).

### Graphene Culture Stimulation of Schwann Cell Alignment



## ACKNOWLEDGMENTS

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## CONTACT INFORMATION

Jung Yul Lim, Ph.D., Associate Professor  
Department of Mechanical and Materials Engineering, University of Nebraska-Lincoln  
W317.3 Nebraska Hall, Lincoln, NE 68588-0526  
Tel: 402-472-2480; Fax: 402-472-1465; E-mail: jlim4@unl.edu; <http://www.TheLimLab.org>