Research Statement

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THE PROBLEM I WORK ON

Nanoscale materials behave differently once they meet living cells, and most of the difficulty in translating a platform lies in that transition rather than in the material itself. My work sits at that boundary: designing structures whose behaviour is controlled at the nanometre scale, then proving what they actually do inside cells and in an animal.

WHAT I ESTABLISHED DURING MY DOCTORATE

At the Shanghai Institute of Materia Medica, Chinese Academy of Sciences, I designed a **mesoporous polydopamine-based Pickering emulsion** that carries two agents with fundamentally incompatible solubility and release requirements in a single particle: shikonin, which inhibits PKM2 and suppresses tumour glycolysis, and JQ1, a BET bromodomain inhibitor. Building it was a materials problem — pore architecture, stabilisation of an oil–water interface by solid particles, drug loading and encapsulation efficiency, particle size distribution and polydispersity, surface charge, colloidal stability and release kinetics, each measured rather than inferred.

Establishing what it did was a cell-biology problem. Using confocal and fluorescence imaging, cellular uptake and viability assays, flow cytometry, immunofluorescence, immunohistochemistry, Western blot, RT-qPCR and ELISA, I showed the system induced **apoptosis** while simultaneously blocking **epithelial–mesenchymal transition** and **vasculogenic mimicry** — three independent escape routes closed at once, which is what produced suppression of both primary tumour growth and lung metastasis. Published in *Acta Pharmacologica Sinica* 46(12):3314-3326, **joint first author, equal contribution formally recorded**.

I then ran the complete in vivo programme unaided: study design and institutional ethics approval, dosing and route selection, longitudinal monitoring across multi-arm cohorts, biodistribution, terminal tissue collection, histopathology and organ-toxicity assessment. I subsequently extended the platform into a thermosensitive hydrogel for placement at a resection site.

WHAT I WOULD CONTRIBUTE HERE

Nanostructured platforms that behave reproducibly at the cell interface. The step that usually fails is not fabrication but reproducibility once biology is involved — aggregation, protein corona, batch variation, loss of payload. Controlling those is what I have spent eight years on, and it transfers directly to any platform intended to interface with human stem cells.

Evidence that the platform did what it claims. High-resolution imaging to localise material within cells, target engagement by Western blot and RT-qPCR, and quantitative readouts by flow cytometry — so that a negative result can be attributed to the biology rather than to the device, which is a distinction that saves months.

The translational end. Drug discovery and precision therapeutics both eventually require an animal result, and I have designed, run and published that work independently.

WHAT I WOULD BE LEARNING

Stem-cell culture and differentiation, micro- and nano-device fabrication, and single-cell or bulk omics with their bioinformatics are all new to me, and I would rather state that than let it be discovered. Two of the three are techniques with steep but well-defined learning curves. The evidence I can offer that I acquire methods quickly is that the entire analytical and molecular toolkit described above was learned from nothing during my doctorate, to a standard where I was training others in it.

RECORD

Seven peer-reviewed publications, 324 citations, h-index 3 (Google Scholar, July 2026); three as first or joint first author. One filed Indian patent (No. 202421042057) on a transdermal delivery system, carried from formulation concept through in vitro efficacy and in vivo safety evidence to filing. Doctoral research funded throughout by the ANSO Young Talent and Belt and Road Government Fellowships. Full publication list with DOIs accompanies this statement.