

ALTERNATIVE AND SUSTAINABLE TESTING: *EX VIVO* HUMAN SKIN EXPLANTS FOR NANOMATERIALS DERMAL ABSORPTION ASSESSMENT

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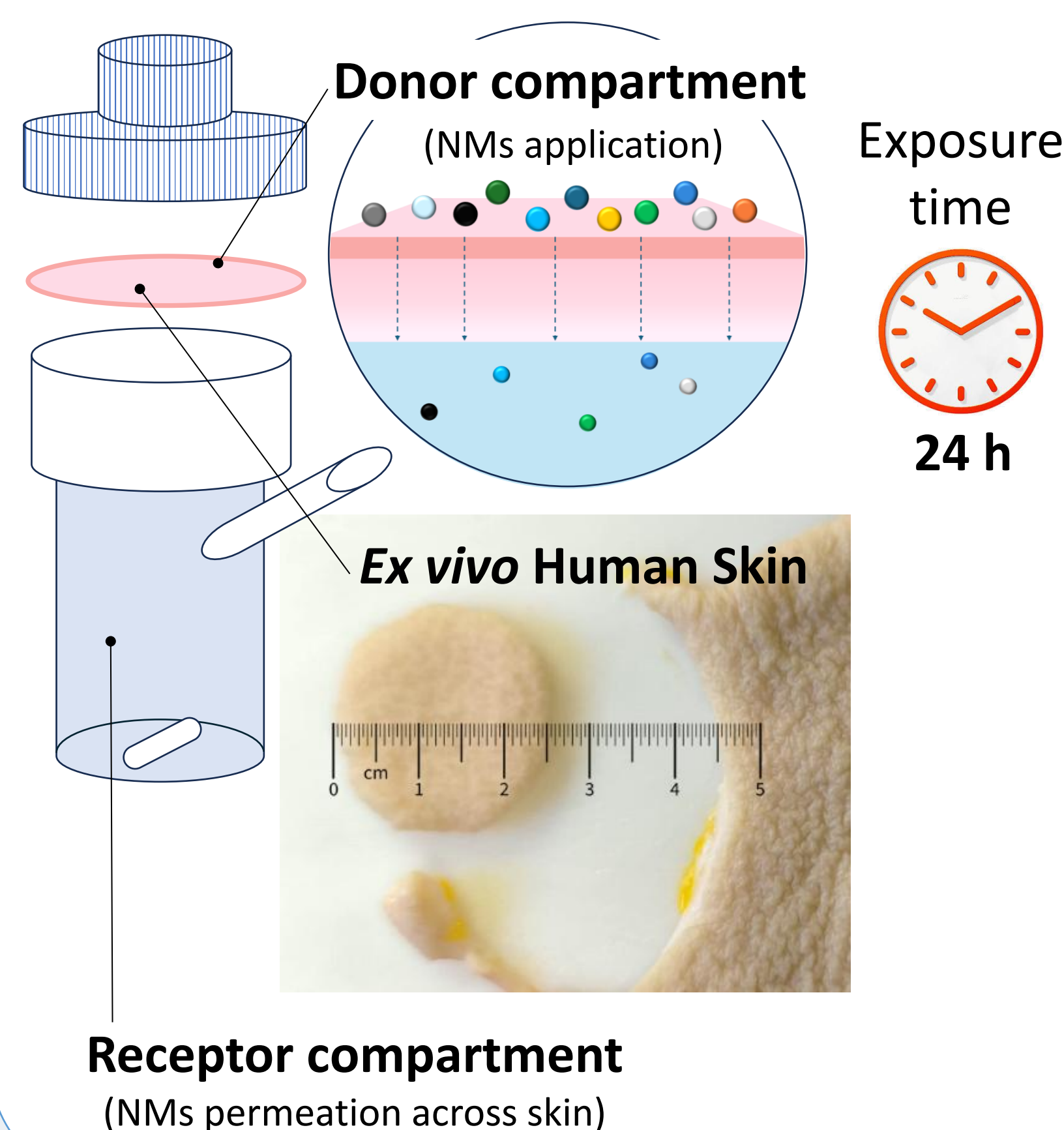
INTRODUCTION

- Nanotechnology-enabled products may lead to dermal exposure to metallic nanomaterials (NMs)
- Human-relevant New Approach Methodologies (NAMs) are needed to support reliable safety assessment without animal testing
- Ex vivo* human skin explants preserve the native skin architecture and represent a relevant model for dermal permeation studies

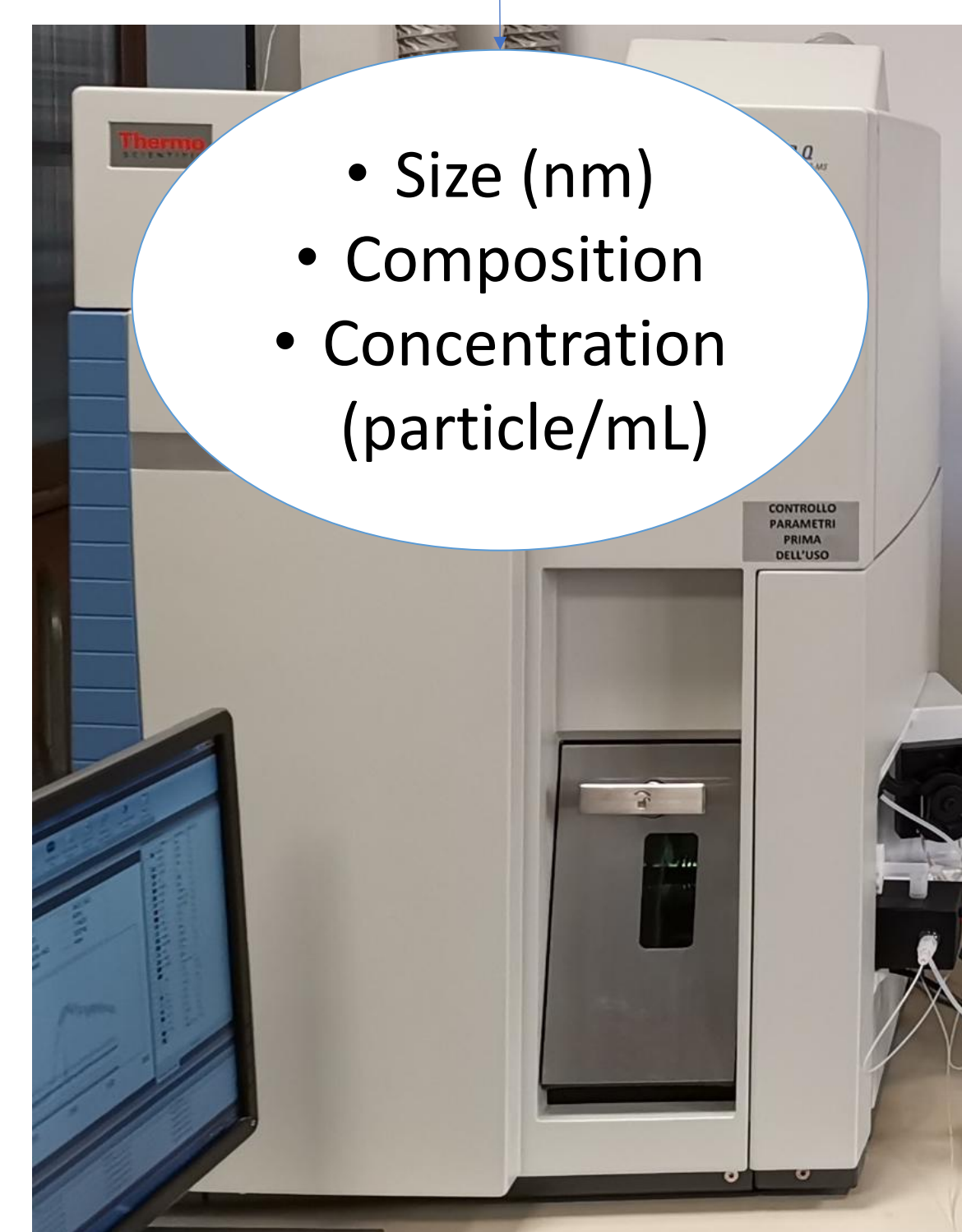
AIM

To develop an *ex vivo* human skin permeation model integrating Franz diffusion cells and Single Particle Inductively Coupled Plasma Mass Spectrometry (SP-ICP-MS) to characterize the dermal permeation of metallic NMs, providing particle size- and particle number-based information for nanosafety assessment

EXPERIMENTS

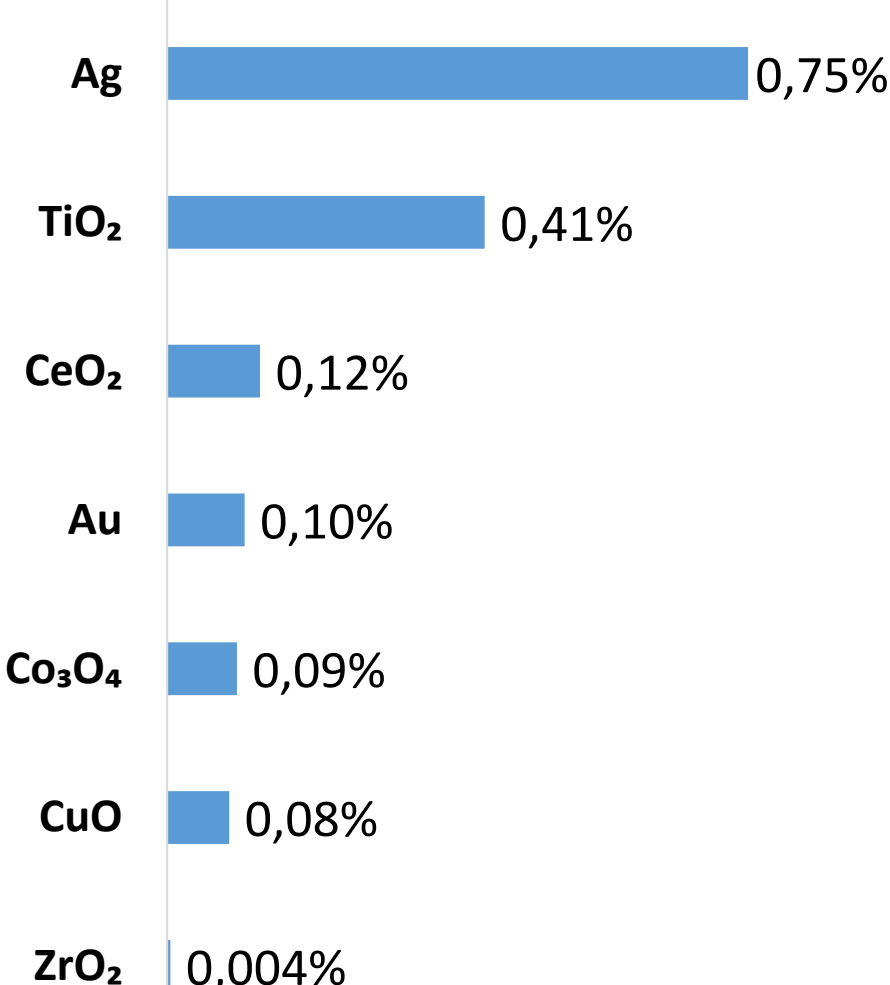


Single Particle ICP-MS analysis

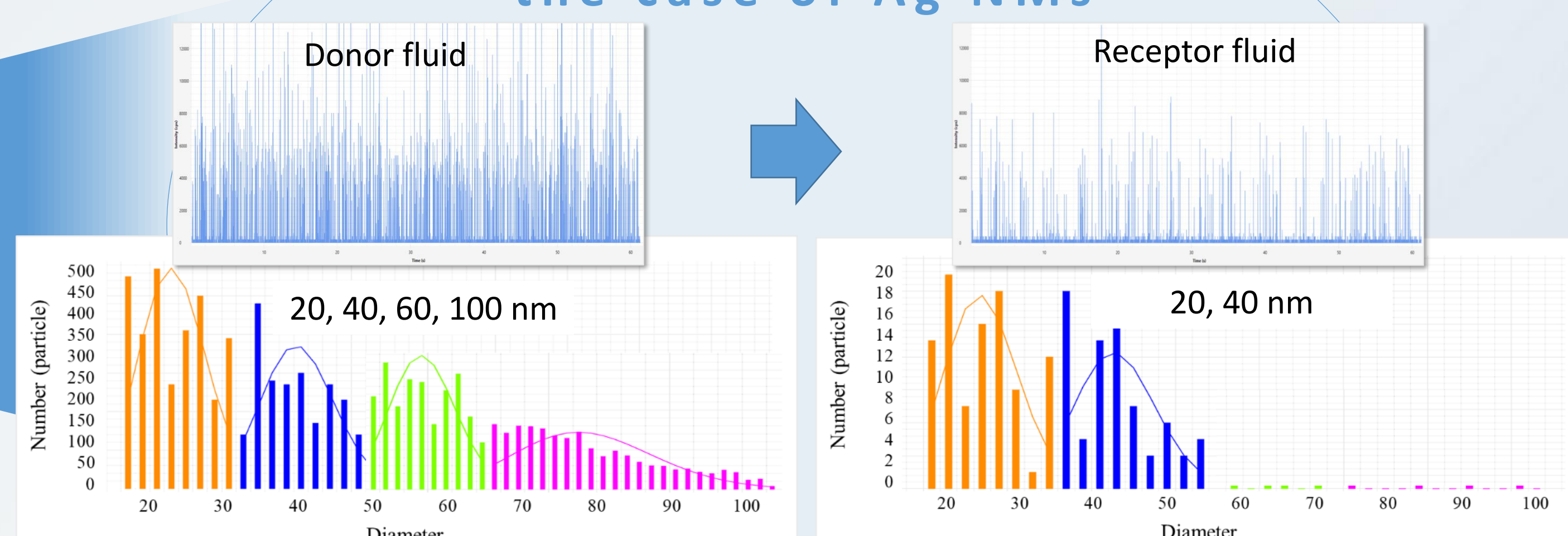


NMs SKIN PERMEATION

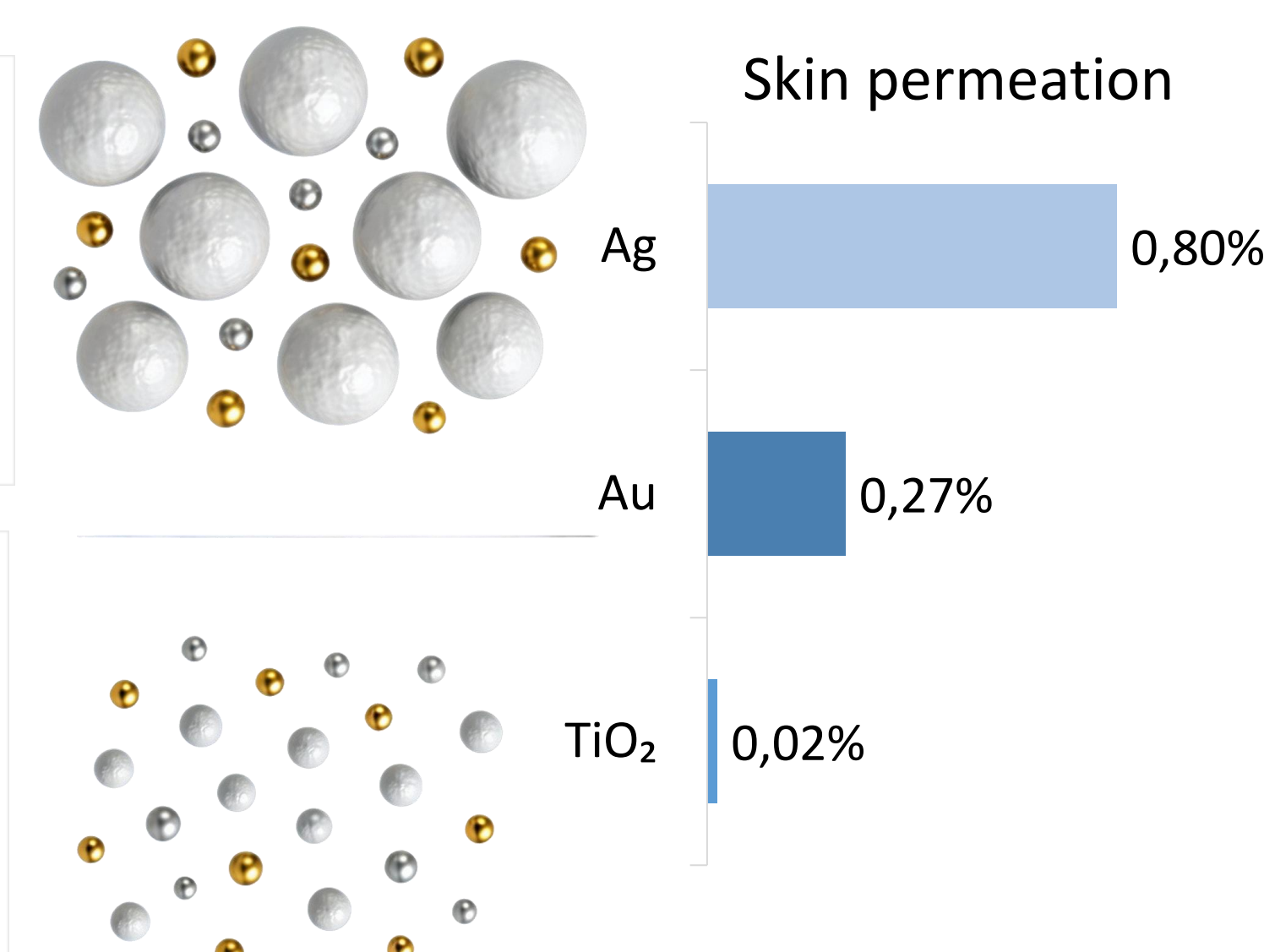
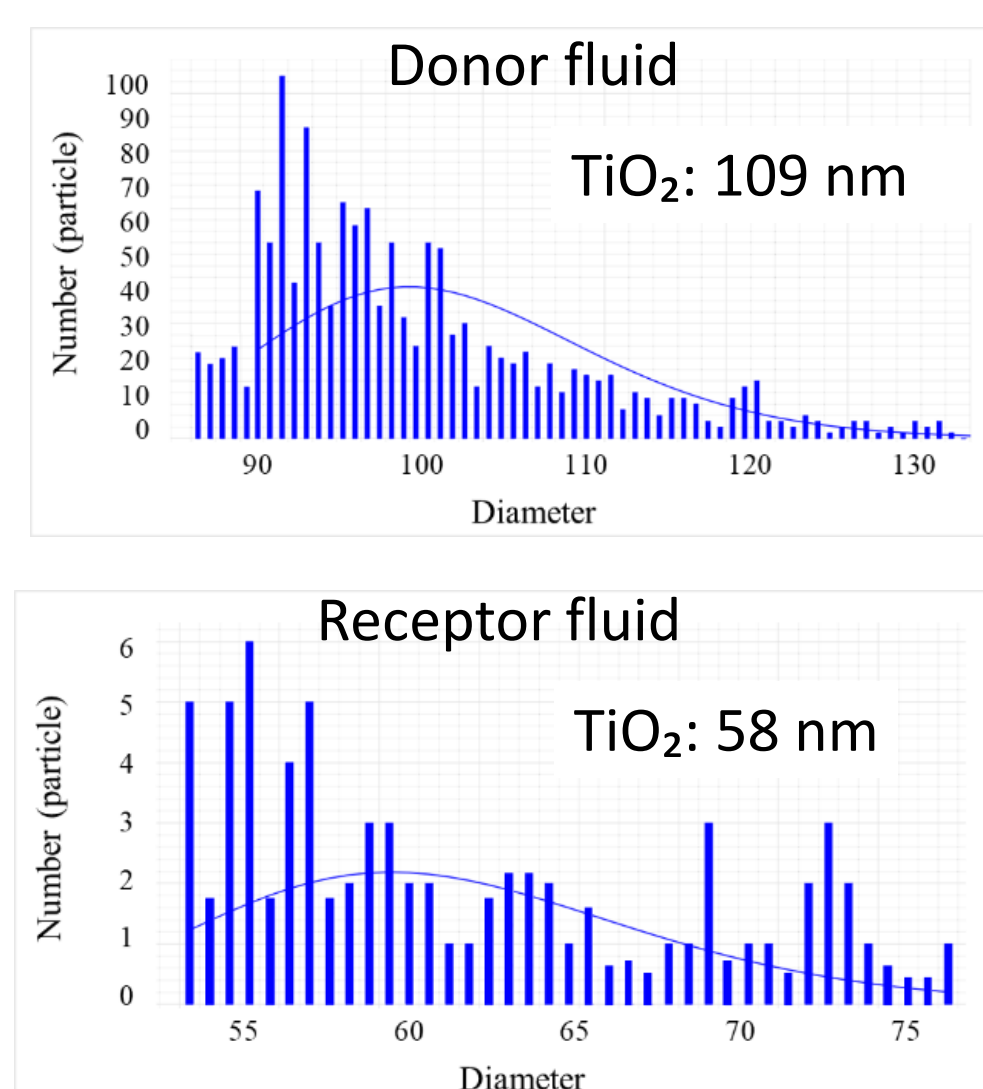
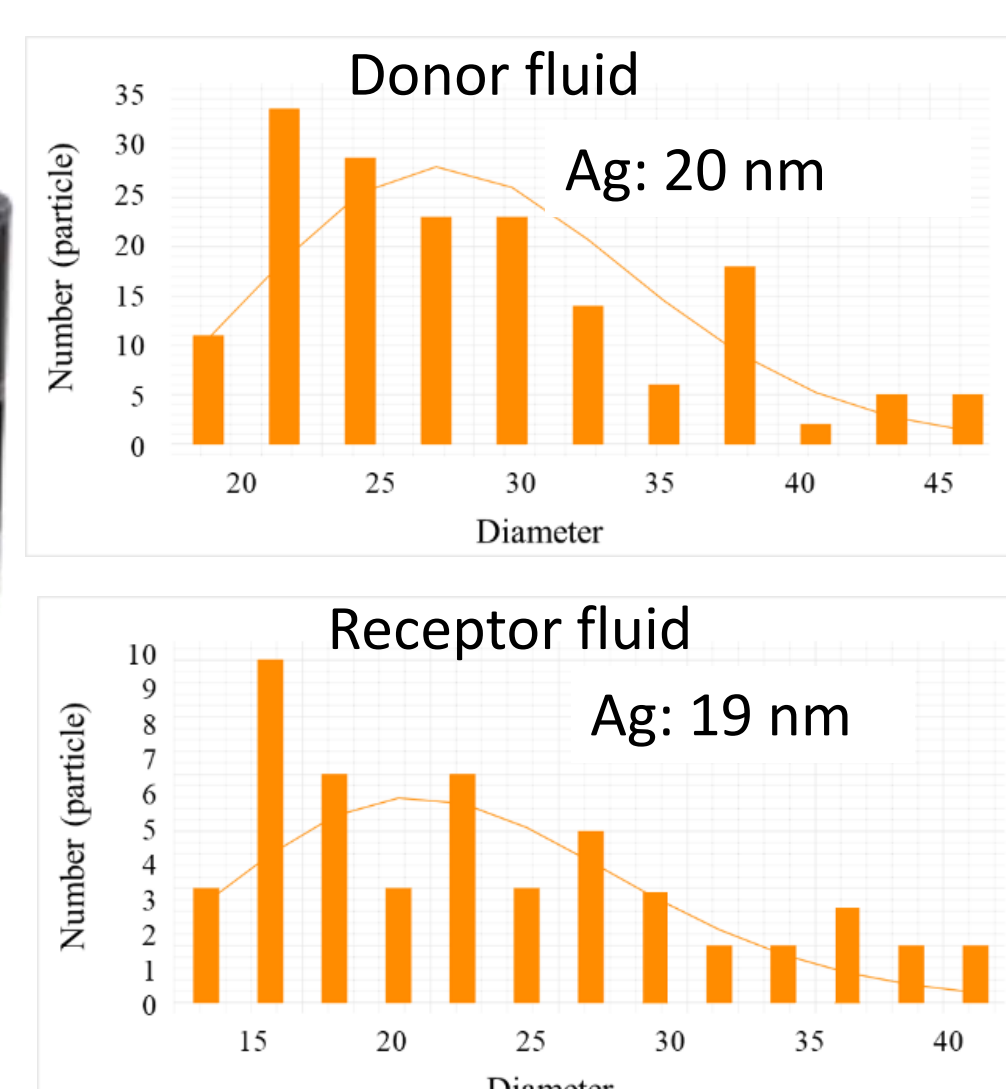
NMs	Donor fluid Size±sd (nm)	Receptor fluid Size±sd (nm)
Ag	27.7±2.3	25.9±2.5
Al ₂ O ₃	32.5±2.1	nd
Au	24.4±2.1	17.5±2.9
CeO ₂	46.6±1.5	43.4±1.7
Co ₃ O ₄	35.6±3.3	33.7±1.8
Cr ₂ O ₃	65.8±1.8	nd
CuO	49.0±1.3	43.8±4.1
Mn ₃ O ₄	32.6±2.4	nd
NiO	34.0±1.8	nd
TiO ₂	38.4±6.9	33.6±7.3
ZnO	37.1±1.9	nd
ZrO ₂	54.4±1.6	50.8±6.4
nd, not detected		



Influence of particle size: the case of Ag NMs



APPLICATION TO COSMETIC PRODUCTS



TAKE-HOME MESSAGES

Dermal permeation remained below 1%
Preferential permeation of smaller particles (<50 nm)

Metal composition + particle size key determinants of skin permeation behaviour

CONCLUSION

The proposed NAM-based approach represents a reliable and sustainable alternative for nanosafety assessment, supporting both product safety evaluation and regulatory decision-making

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