

EPSRC Marine Wave Energy Programme

Bionic Adaptive Stretchable Materials for WEC (BASM-WEC)

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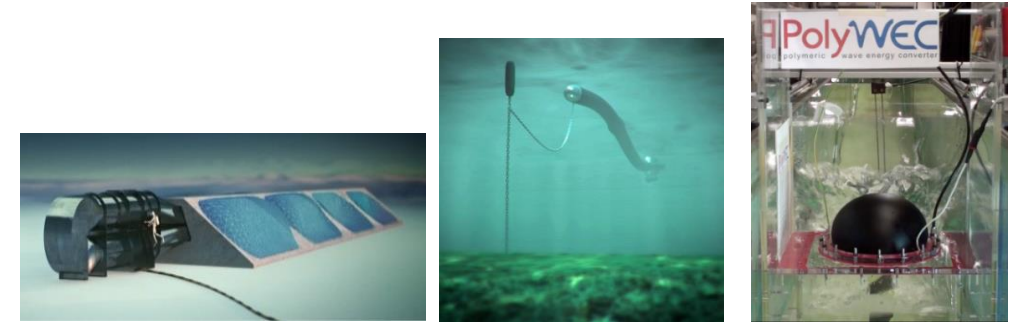
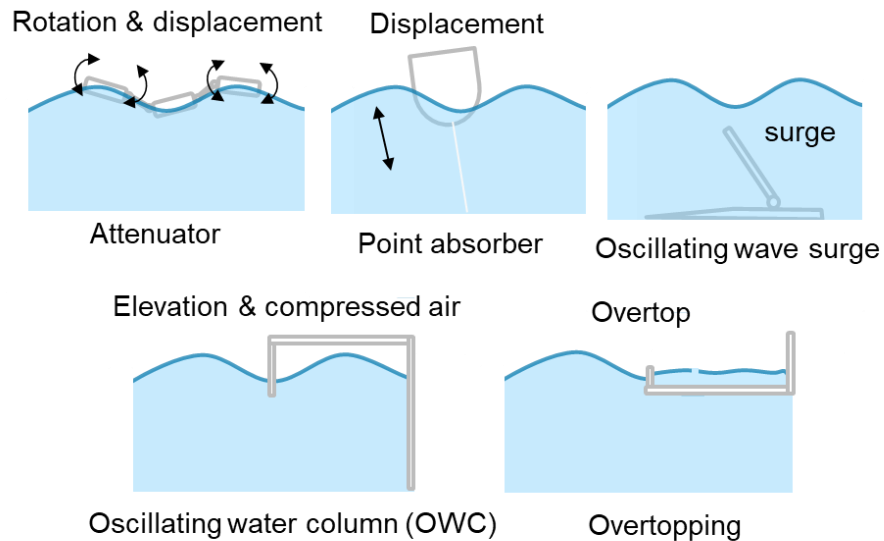


Background

Traditional WEC

Aquatic animals' flexible body & fins

Flexible components WEC



Bombora mWave

Anaconda

PolyWEC OWC

- Rigid material components
- Low-performance efficiency and system vulnerability under harsh sea conditions: time-dependent variable loadings

- Part of WEC structures are flexible (PTO or primary mover)
- Lighter and low cost vs rigid WEC
- Flexible deformation adapting to time-dependent loading
- Excellent manoeuvrability, low noise, etc.

Motivation and Objectives

❑ Limited materials are used

Can we find/develop functionally driven materials, suitable for WEC structures that actively or passively change their material characteristics in extreme ocean environment conditions, but are stiff enough to capture the energy under normal operating conditions?

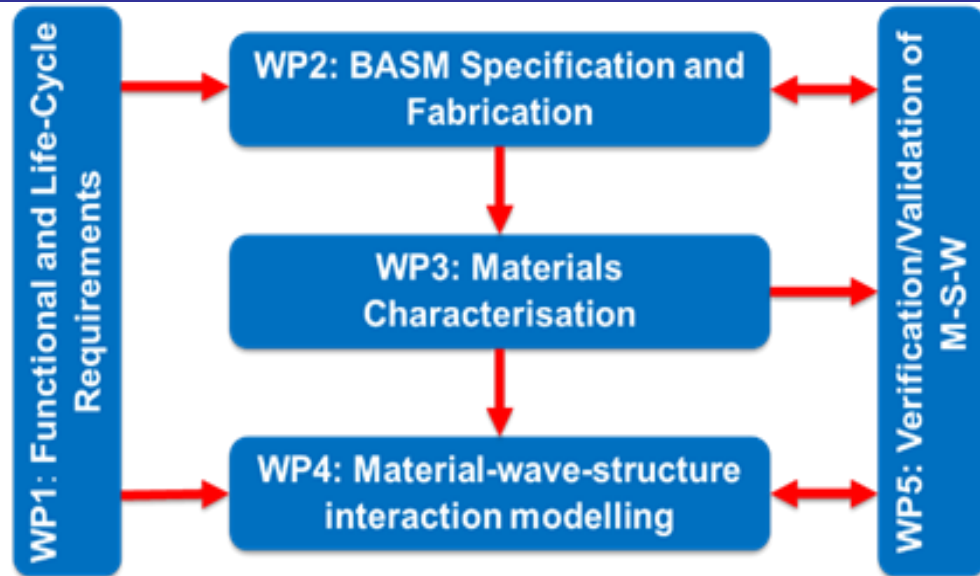
❑ Analysis technique is either limited or highly case dependent

Can we perform a fully-nonlinear hydrodynamic loading estimation, to allow simulation of fluid-structure behaviour of multiple flexible bodies in a realistic environment wave conditions?

❑ A life-cycle assessment for the design of functionality and new materials for more sustainable WEC is missing

❑ The main aim of the project: to develop an analysis and laboratory testing integrity toolbox to reliably design, analyse, and process the state-of-the-art adaptive stretchable materials and structures applicable to WECs.

Work Packages



- **WP1 Functional & Life-Cycle Requirements**

(Xiao, Day, Yang, RA2 & RA3) (8 months)

Task 1.1 Wave and material conditions

Task 1.2 Life-Cycle Assessment

- **WP2 BASM Specification and Fabrication**

(Bomphray, Brennan, RA1) (15 months)

Task 2.1 BASM specification

Task 2.2 BASM fabrication

- **WP3 Materials Characterisation**

(Brennan, Yang, Bomphray, RA1 & RA2) (24 months)

Task 3.1 Standard test for initial design input

Task 3.2 Failure test under saltwater

Task 3.3 Saltwater ageing under loading

- **WP4 Material-wave-structure Interaction Modelling**

(Xiao, RA1 & RA3) (36 months)

Task 4.1 Code development

Task 4.2 Lower-order hydro-elastic analysis & simple models

Task 4.3 Flexible WEC hydrodynamic and structural analysis

- **WP5 Verification/validation**

(Day, Bomphray, RA2 & RA3) (12 months)

Task 5.1 Structure manufacturing and Verification

Task 5.2 Small scale models fabrication and model validation

Material

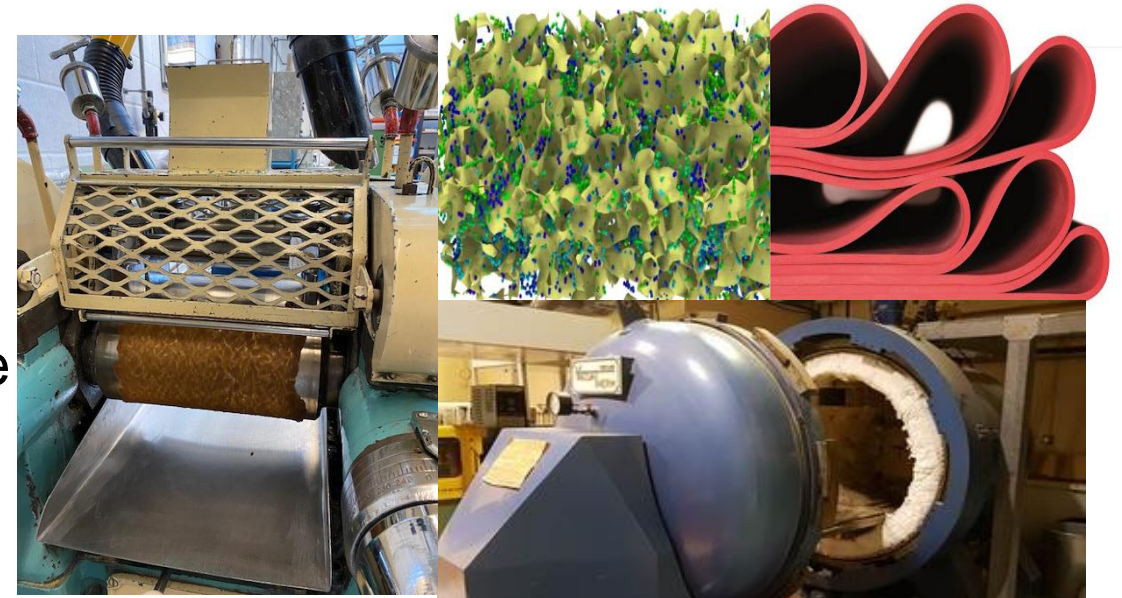
There are 3 key aspects in material WPs:

❑ Material design for functional flexible WEC

- ✓ Existing material candidates (e.g. elastomers, polymers, composites) will be examined to evaluate 'Pros and Cons' of commercial materials for WEC applications
- ✓ Material design guided by Fluid-Structure-Energy interactive modelling
- ✓ Define material composition (e.g. formulation, filler, coating) and microstructure

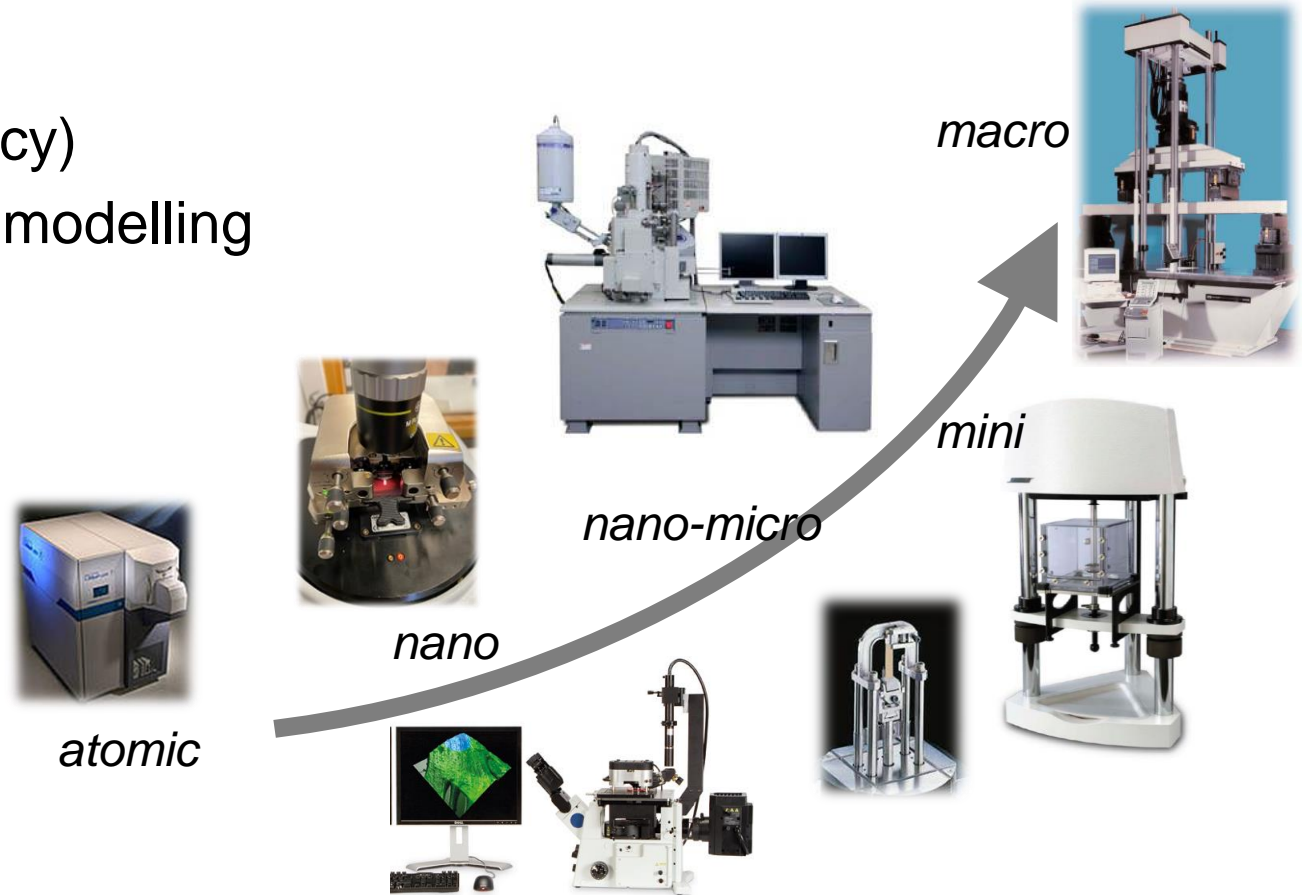
❑ Material processing

- ✓ Material modification based on new design
- ✓ Identify suitable material processing route
- ✓ Material manufacturing to provide coupon sample



❑ Material characterisation

- ✓ Multi-scale material testing
- ✓ Functionality (e.g. energy efficiency)
- ✓ Provide material input into F-S-E modelling



Thank You !

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