Supplementary data

The raw/processed data required to reproduce these findings cannot be shared at this time as the data also forms part of an ongoing study.

RVE size validation

Mesostructures A, B and C should not be compared: used material data are not the same, these results have only been used to check the RVE size.

Stiffness matrices (GPa) for several samples of mesostructure type A.

$$C_{ijkl} = \begin{bmatrix} 12.8 & 2.8 & 2.8 & 0 & 0 & 0 \\ 2.8 & 12.5 & 2.7 & 0 & 0 & 0 \\ 2.8 & 2.7 & 12.0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 5.0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 4.8 & 0 \\ 0 & 0 & 0 & 0 & 0 & 4.8 \end{bmatrix}_{Mesostructure\ A-Draw\ 1}$$

$$C_{ijkl} = \begin{bmatrix} 12.4 & 2.7 & 2.7 & 0 & 0 & 0 \\ 2.7 & 11.9 & 2.6 & 0 & 0 & 0 \\ 2.7 & 2.6 & 11.1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 4.9 & 0 & 0 \\ 0 & 0 & 0 & 0 & 4.6 & 0 \\ 0 & 0 & 0 & 0 & 0 & 4.6 \end{bmatrix}_{Mesostructure\ A-Draw\ 2}$$

$$C_{ijkl} = \begin{bmatrix} 11.7 & 2.5 & 2.5 & 0 & 0 & 0 \\ 2.5 & 10.5 & 2.3 & 0 & 0 & 0 \\ 2.5 & 2.3 & 9.7 & 0 & 0 & 0 \\ 0 & 0 & 0 & 4.5 & 0 & 0 \\ 0 & 0 & 0 & 0 & 4.2 & 0 \\ 0 & 0 & 0 & 0 & 0 & 4.1 \end{bmatrix}_{Mesostructure\ A-Draw\ 3}$$

$$C_{ijkl} = \begin{bmatrix} 10.9 & 2.4 & 2.4 & 0 & 0 & 0 \\ 2.4 & 10.6 & 2.3 & 0 & 0 & 0 \\ 2.4 & 2.3 & 9.9 & 0 & 0 & 0 \\ 0 & 0 & 0 & 4.5 & 0 & 0 \\ 0 & 0 & 0 & 0 & 4.1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 4.0 \end{bmatrix}_{Mesostructure\ A-Draw\ 4}$$

$$C_{ijkl} = \begin{bmatrix} 13.4 & 3.0 & 2.9 & 0 & 0 & 0 \\ 3.0 & 12.9 & 3.0 & 0 & 0 & 0 \\ 2.9 & 3.0 & 12.5 & 0 & 0 & 0 \\ 0 & 0 & 0 & 4.9 & 0 & 0 \\ 0 & 0 & 0 & 0 & 4.6 & 0 \\ 0 & 0 & 0 & 0 & 0 & 4.6 \end{bmatrix}_{Mesostructure\ A-Draw\ 5}$$

$$C_{ijkl} = \begin{bmatrix} 13.3 & 3.0 & 2.9 & 0 & 0 & 0 \\ 3.0 & 13.2 & 2.9 & 0 & 0 & 0 \\ 2.9 & 2.9 & 11.6 & 0 & 0 & 0 \\ 0 & 0 & 0 & 5.3 & 0 & 0 \\ 0 & 0 & 0 & 0 & 4.8 & 0 \\ 0 & 0 & 0 & 0 & 0 & 4.9 \end{bmatrix}_{Mesostructure\ A-Draw\ 6}$$

Stiffness matrices (GPa) for several samples of mesostructure type B.

$$C_{ijkl} = \begin{bmatrix} 0.11 & 0.03 & 0.03 & 0 & 0 & 0 \\ 0.03 & 0.10 & 0.03 & 0 & 0 & 0 \\ 0.03 & 0.03 & 0.12 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.04 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0.05 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0.05 \end{bmatrix}_{Mesostructure\ B-Draw\ 1}$$

$$C_{ijkl} = \begin{bmatrix} 0.14 & 0.03 & 0.03 & 0 & 0 & 0 \\ 0.03 & 0.14 & 0.02 & 0 & 0 & 0 \\ 0.03 & 0.02 & 0.12 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.05 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0.04 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0.04 \end{bmatrix}_{Mesostructure\ B-Draw\ 2}$$

$$C_{ijkl} = \begin{bmatrix} 0.13 & 0.03 & 0.03 & 0 & 0 & 0 \\ 0.03 & 0.14 & 0.03 & 0 & 0 & 0 \\ 0.03 & 0.03 & 0.13 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.06 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0.06 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0.05 \end{bmatrix}_{Mesostructure\ B-Draw\ 3}$$

$$C_{ijkl} = \begin{bmatrix} 0.12 & 0.03 & 0.02 & 0 & 0 & 0 \\ 0.03 & 0.11 & 0.02 & 0 & 0 & 0 \\ 0.02 & 0.02 & 0.10 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.04 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0.04 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0.04 \end{bmatrix}_{Mesostructure\ B-Draw\ 4}$$

$$C_{ijkl} = \begin{bmatrix} 0.14 & 0.01 & 0.01 & 0 & 0 & 0 \\ 0.01 & 0.10 & 0.03 & 0 & 0 & 0 \\ 0.01 & 0.03 & 0.10 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.05 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0.04 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0.05 \end{bmatrix}_{Mesostructure\ B-Draw\ 5}$$

$$C_{ijkl} = \begin{bmatrix} 0.12 & 0.03 & 0.03 & 0 & 0 & 0 \\ 0.03 & 0.12 & 0.02 & 0 & 0 & 0 \\ 0.03 & 0.02 & 0.10 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.05 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0.05 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0.04 \end{bmatrix}_{Mesostructure\ B-Draw\ 6}$$

Stiffness matrices (GPa) for several samples of mesostructure type C.

$$C_{ijkl} = \begin{bmatrix} 0.15 & 0.03 & 0.04 & 0 & 0 & 0 \\ 0.03 & 0.15 & 0.04 & 0 & 0 & 0 \\ 0.04 & 0.04 & 0.17 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.06 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0.06 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0.07 \end{bmatrix}_{Mesostructure\ C-Draw\ 1}$$

$$C_{ijkl} = \begin{bmatrix} 0.18 & 0.05 & 0.04 & 0 & 0 & 0 \\ 0.05 & 0.17 & 0.04 & 0 & 0 & 0 \\ 0.04 & 0.04 & 0.14 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.08 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0.06 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0.05 \end{bmatrix}_{Mesostructure\ C-Draw\ 2}$$

$$C_{ijkl} = \begin{bmatrix} 0.18 & 0.05 & 0.05 & 0 & 0 & 0 \\ 0.05 & 0.14 & 0.05 & 0 & 0 & 0 \\ 0.05 & 0.05 & 0.14 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.05 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0.07 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0.07 \end{bmatrix}_{Mesostructure\ C-Draw\ 3}$$

$$C_{ijkl} = \begin{bmatrix} 0.13 & 0.03 & 0.03 & 0 & 0 & 0 \\ 0.03 & 0.15 & 0.03 & 0 & 0 & 0 \\ 0.03 & 0.03 & 0.14 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.05 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0.07 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0.07 \end{bmatrix}_{Mesostructure\ C-Draw\ 4}$$

$$C_{ijkl} = \begin{bmatrix} 0.17 & 0.04 & 0.03 & 0 & 0 & 0 \\ 0.04 & 0.20 & 0.04 & 0 & 0 & 0 \\ 0.03 & 0.04 & 0.18 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.08 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0.05 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0.05 \end{bmatrix}_{Mesostructure\ C-Draw\ 5}$$

$$C_{ijkl} = \begin{bmatrix} 0.15 & 0.03 & 0.04 & 0 & 0 & 0 \\ 0.03 & 0.15 & 0.04 & 0 & 0 & 0 \\ 0.04 & 0.04 & 0.17 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.06 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0.06 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0.07 \end{bmatrix}_{Mesostructure\ C-Draw\ 6}$$

Mesh refinement

Stiffness matrices (GPa) for two identical samples with two different meshes

Fine mesh:

$$C_{ijkl} = \begin{bmatrix} 0.15 & 0.03 & 0.04 & 0 & 0 & 0 \\ 0.03 & 0.15 & 0.04 & 0 & 0 & 0 \\ 0.04 & 0.04 & 0.17 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.06 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0.06 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0.07 \end{bmatrix}_{Mesostructure\ C-Finer\ mesh}$$

Coarse mesh:

$$C_{ijkl} = \begin{bmatrix} 0.16 & 0.04 & 0.04 & 0 & 0 & 0 \\ 0.04 & 0.16 & 0.05 & 0 & 0 & 0 \\ 0.04 & 0.05 & 0.18 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.07 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0.06 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0.07 \end{bmatrix}_{Mesostructure\ C-Coarse\ mesh}$$

Mesostructure comparisons

Stiffness matrices (GPa) for mesostructure A, B and C corresponding to the same material data. Data used for the analyze of the mesostructure impact.

Mesostructure A

$$C_{ijkl} = \begin{bmatrix} 0.06 & 0.01 & 0.01 & 0 & 0 & 0 \\ 0.01 & 0.06 & 0.01 & 0 & 0 & 0 \\ 0.01 & 0.01 & 0.06 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.03 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0.03 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0.02 \end{bmatrix}_{Mesostructure\ A}$$

Mesostructure B

$$C_{ijkl} = \begin{bmatrix} 0.12 & 0.03 & 0.03 & 0 & 0 & 0 \\ 0.03 & 0.12 & 0.02 & 0 & 0 & 0 \\ 0.03 & 0.02 & 0.10 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.05 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0.05 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0.04 \end{bmatrix}_{Mesostructure\ B}$$

Mesostructure C

$$C_{ijkl} = \begin{bmatrix} 0.15 & 0.03 & 0.04 & 0 & 0 & 0 \\ 0.03 & 0.15 & 0.04 & 0 & 0 & 0 \\ 0.04 & 0.04 & 0.17 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.06 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0.06 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0.07 \end{bmatrix}_{Mesostructure\ C}$$