Journal of Zhejiang University-SCIENCE A (Applied Physics & Engineering)

Zhejiang University

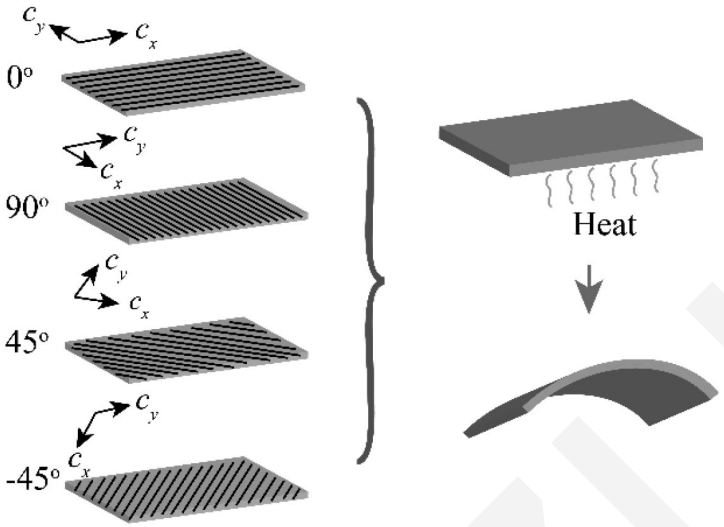
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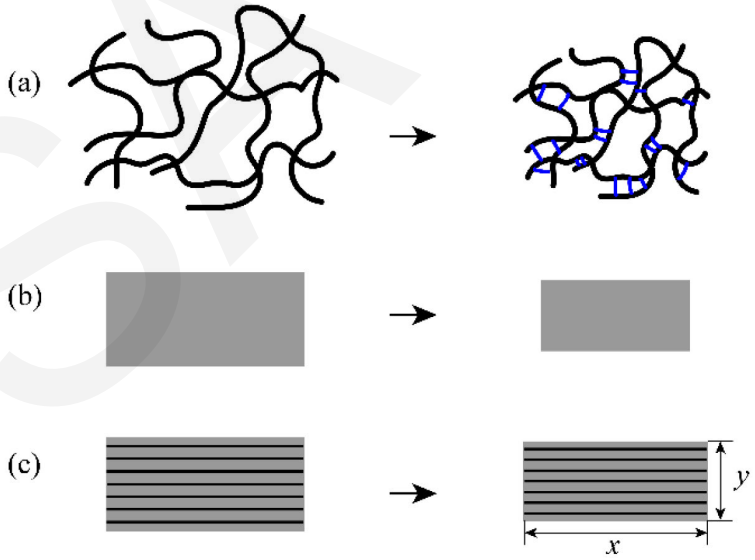
Analysis and control of cured deformation of fiber-reinforced thermosetting composites: a review

Key words:

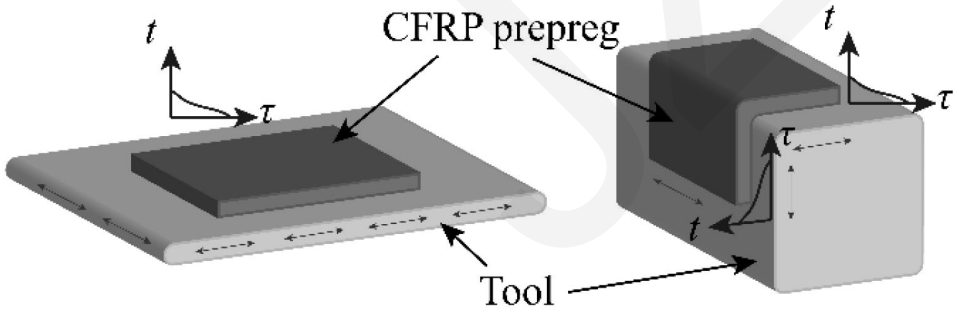
Carbon fiber-reinforced polymer (CFRP); Cured deformation; Finite element analysis (FEA); Process modeling; Control methods

Mechanisms of Composite Cured Deformation





01 Thermal deformation



02 Tool-part interaction

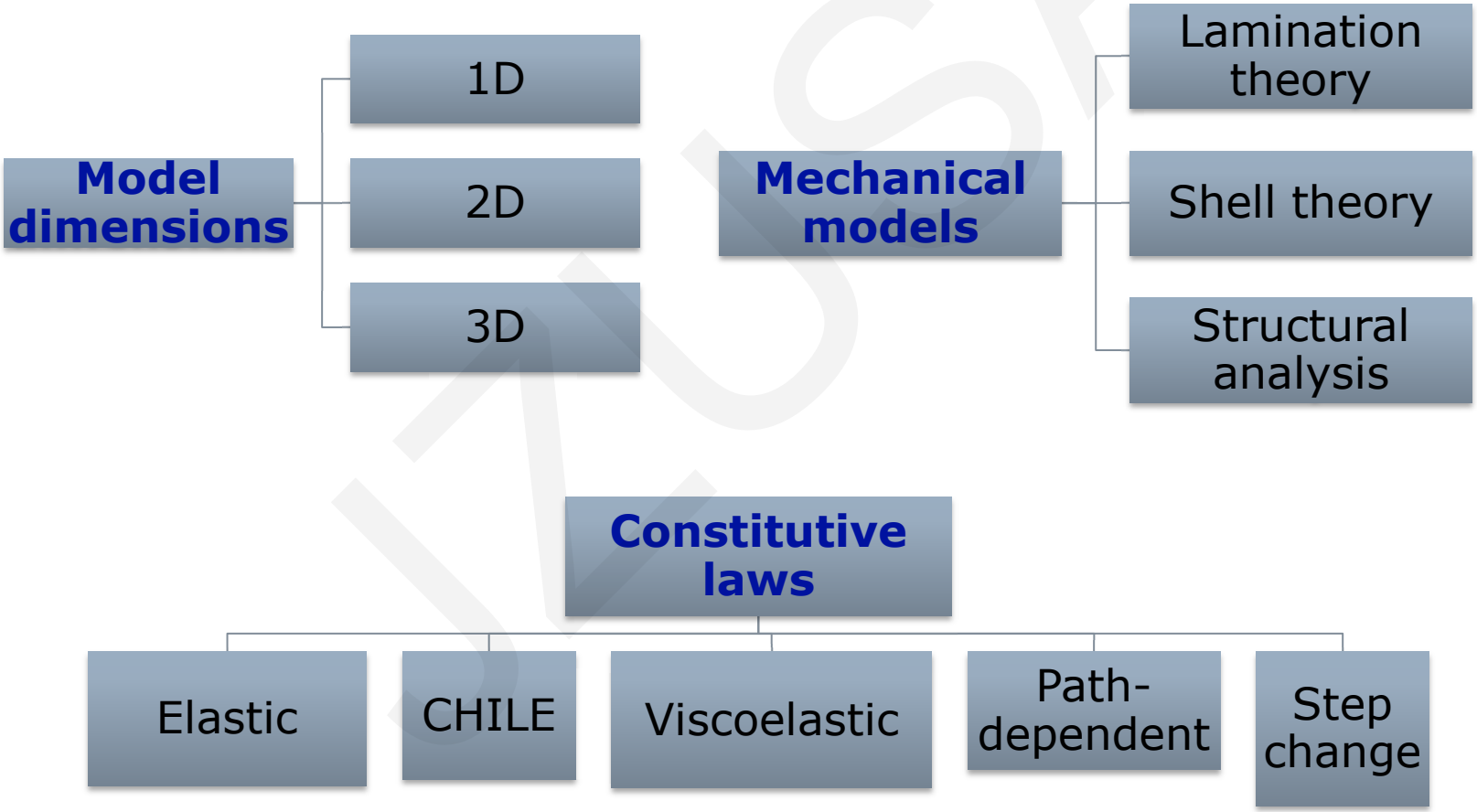
03 Chemical shrinkage of resin

04 Others including:

resin flow,
fiber volume fraction gradients,
stacking sequence,
temperature gradients,
moisture swelling, fiber wrinkling,
degree of cure (DOC) ,
component size and shape, et. al,...

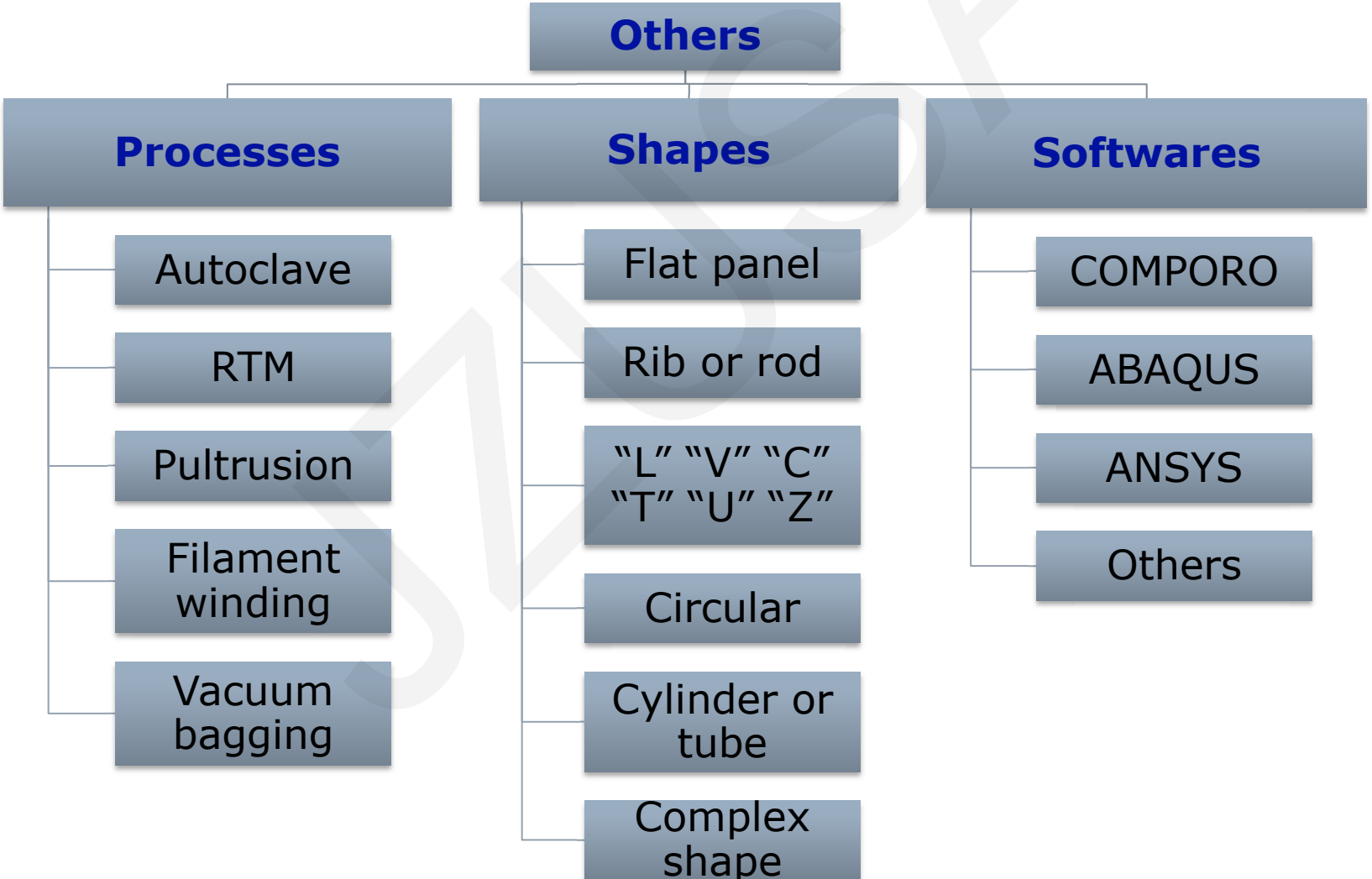
Five Representative control methods

1 Die surface compensation



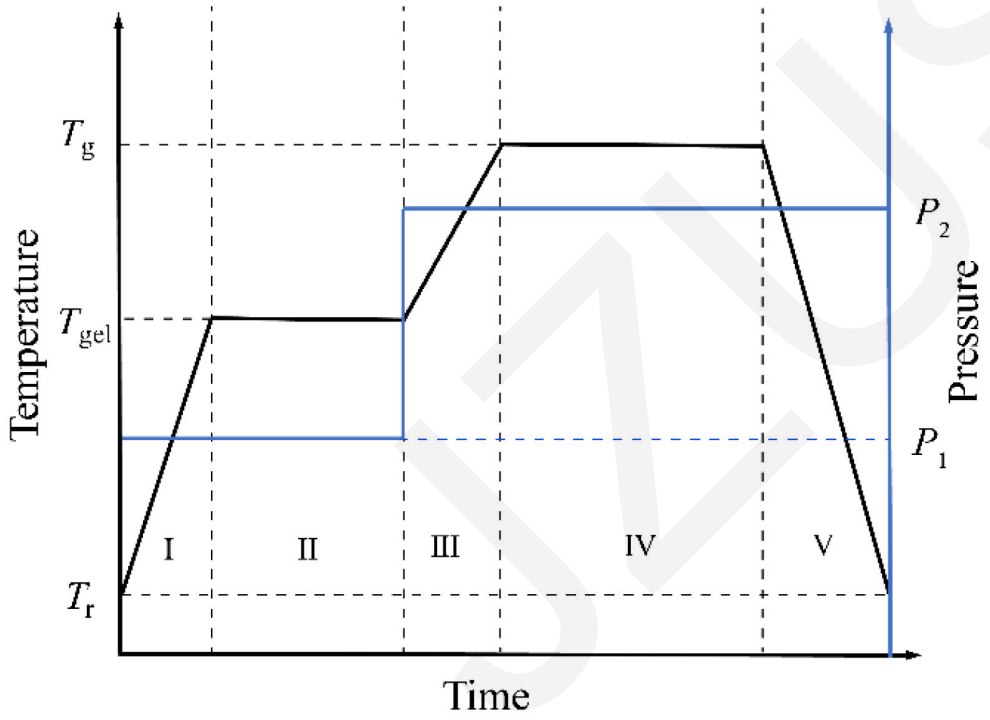
Five Representative control methods

1 Die surface compensation



Five Representative control methods

2 Process optimization



01 Cure cycle

02 Cure temperature

03 Temperature ramp

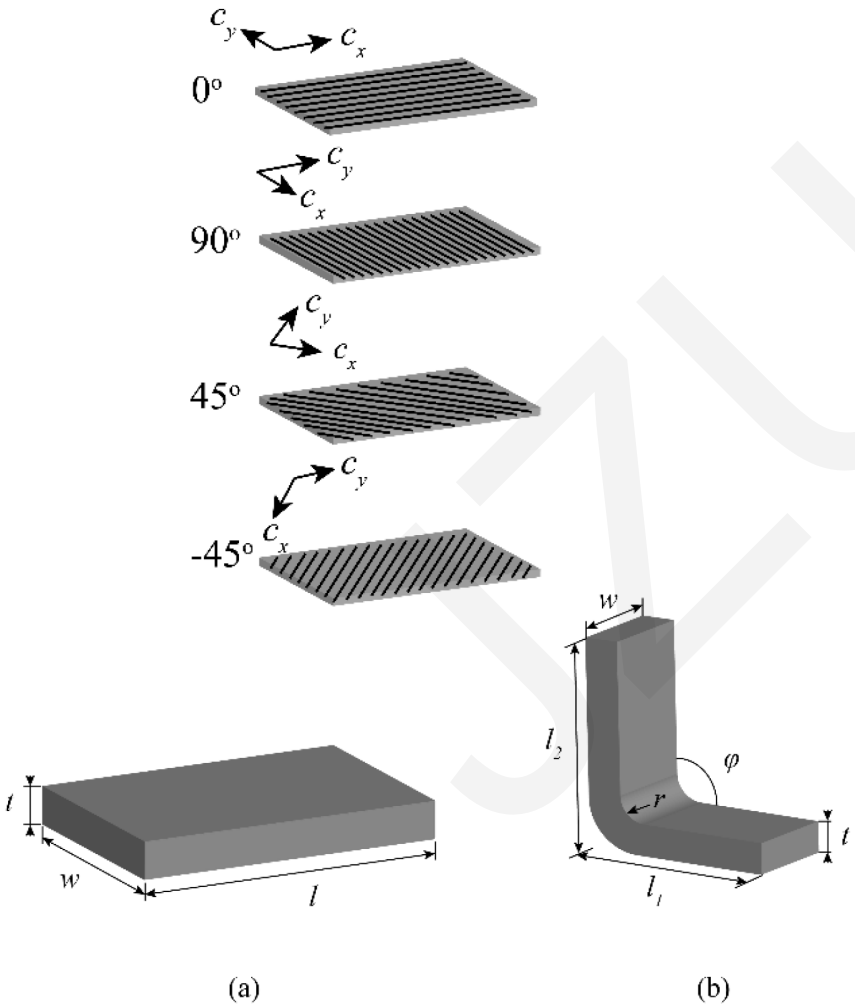
04 Cooling rate

05 Cure time

06 Pressure

Five Representative control methods

3 Structure optimization



- 01 Laminate thickness
- 02 Laminate stacking sequence
- 03 Dimensions
- 04 Fiber volume fraction

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Five Representative control methods

4 Tool-part contact optimization

01 Fluorinated ethylene propylene (FEP) release sheets

02 Tool materials

03 Tool surface coarseness

04 Different setups

5 Development of other measures

01 Resin

- New resin
- Additives

02 New curing processes

- Radiation curing
- Microwave curing

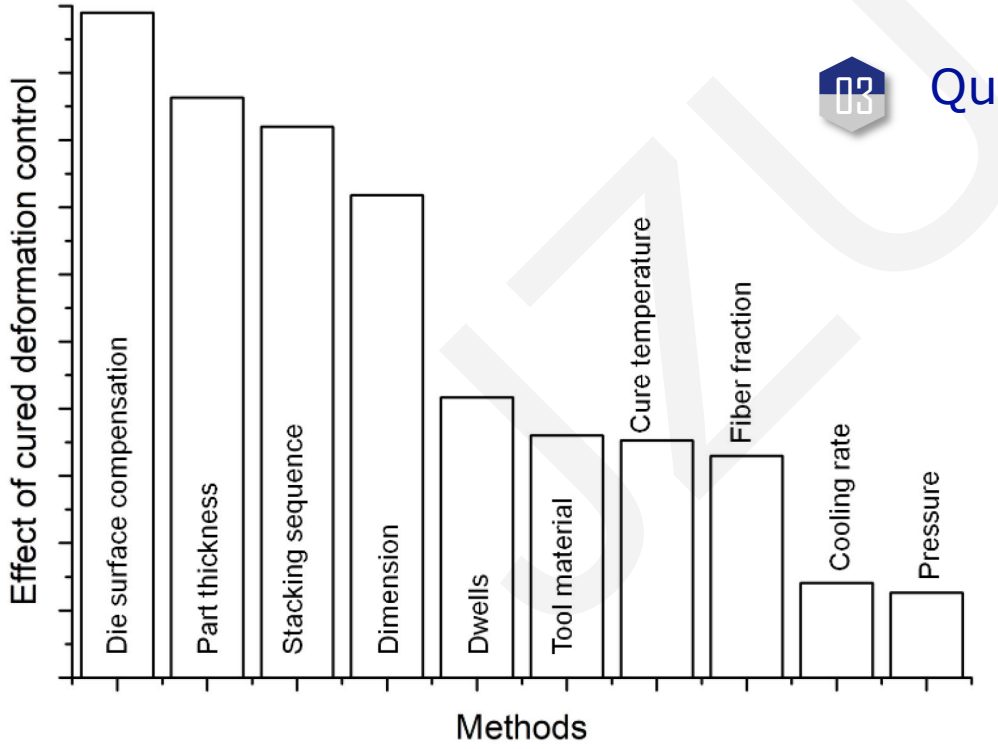
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Discussions and Conclusions

01 The basis of each control method

02 The advantages and disadvantages of each method and its suitable scope

03 Qualitative control effects of methods



04 This problem has not been resolved fundamentally. Sustained efforts from all sides are still needed to overcome this problem.