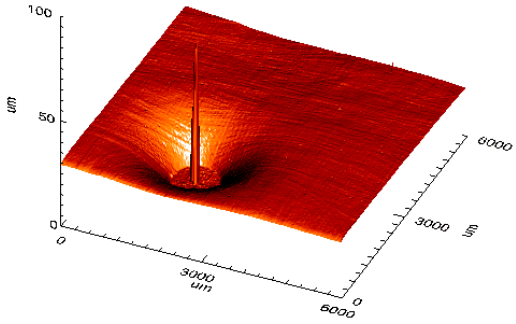
Leibniz-Institut
für Polymerforschung
Dresden

Electron induced 3D-edge modification of SMC-parts

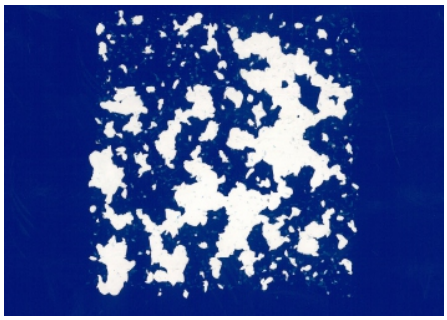
Via analytical investigations on industrially thermal molded SMC-parts post-curing reactions and thermal weight loss caused by outgassing were identified as main reasons for most of the touch ups and rejects, up to now making necessary expensive pre-treatment operations (e.g. primer-sealer, sanding).
A novel electron-pre-treatment results in a parallel post-curing of the edge layer as well as surface functionalization of SMC-parts. After subsequent coating, an increase of coating adhesive strength in combination with a drastic reduction of coating defects is achieved. Robot coupling of low energy electron emitters enables in-line e^- -treatment and an enhanced coating process efficiency.

State of the art

Without expensive extra SMC-part pretreatment operations, coating defects cause a low first run-rate of coated SMC-parts of ~ 70–80%.



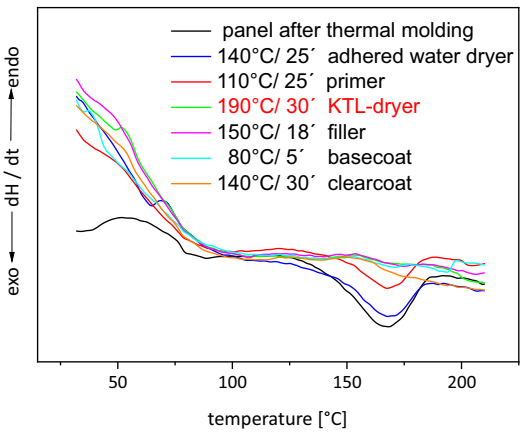
coating defect: e. g. crater



Multi-stone impact test (DBL 5400)

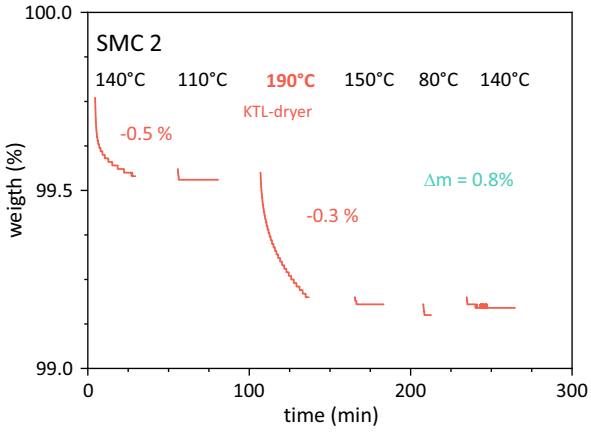
Reasons

Incomplete curing of SMC-parts via thermal molding



Simulation of OEM-coating process temperature conditions via DSC-measurements: Automotive-SMC-body parts are completely cured only after KTL-dryer (190°C/ 30 min)

Outgassing during OEM-coating process

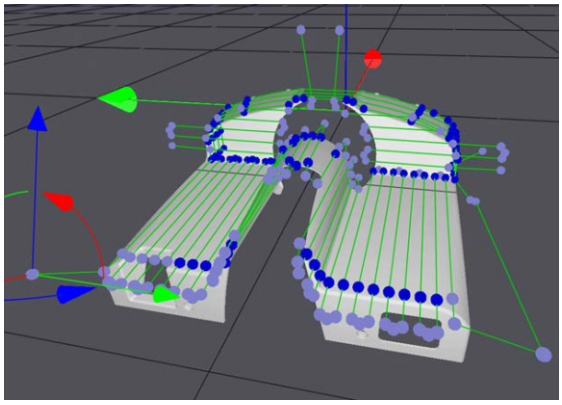


Simulation of OEM-coating process temperature conditions via TGA-measurements: Only after KTL-dryer (190°C/ 30 min) no more weight loss was detectable

Novel process technology

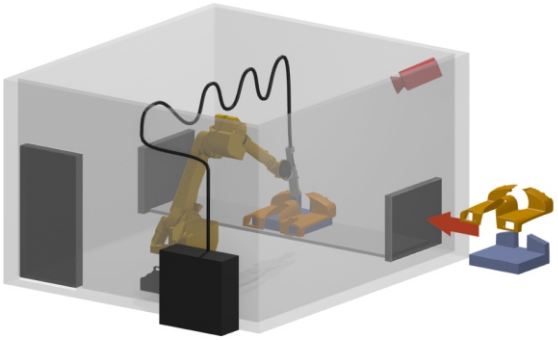
Electron post-curing of SMC-parts as efficient pretreatment before the coating procedure

CAD; calculation of emitter pathway



Part positioning

3D-edge modification



Process for the electron-induced 3D-edge layer modification of industrially molded SMC-parts

Requirement “Class A”-quality

- surface quality (roughness, waviness, adhesion strength)
- physical properties (almost no shrink)
- inline coat ability (equivalent quality to metal parts)

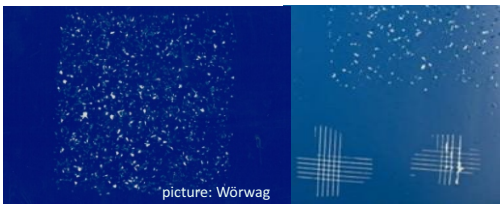
Ergebnisse

	ΔH (J/g)	contact angel (°)	coating quality
prepreg	-25	-	-
after thermal molding	-2.2	100	unacceptable
5 x 20 kGy	0	80	++
6 x 20 kGy	0	73	++
7 x 20 kGy	0	69	++

Influence of electron treatment on residual reactivity ΔH, contact angle values and coating quality

- e- post-curing of molded parts generate a barrier layer and a permanent surface functionalization with hydrophilic groups in one step
- Efficient e- treatment by robot coupled compact low electron energy (150-300 keV) emitters
- In-line process with cycle times < 4 minutes

Coating results



Surface after multi-stone impact (DBL 5400)-and cross cut

Contact

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