Voiding:
Contrary Effects of Voiding

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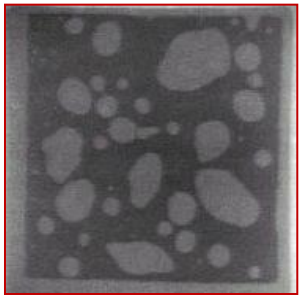
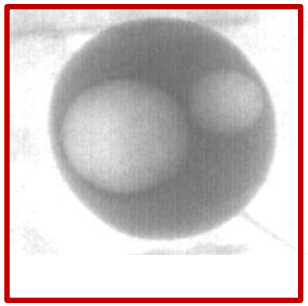
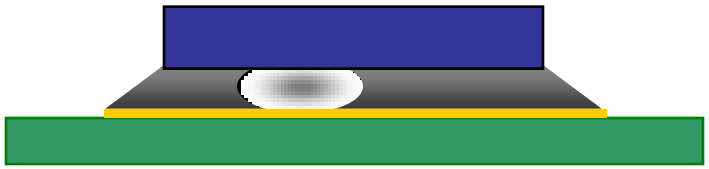
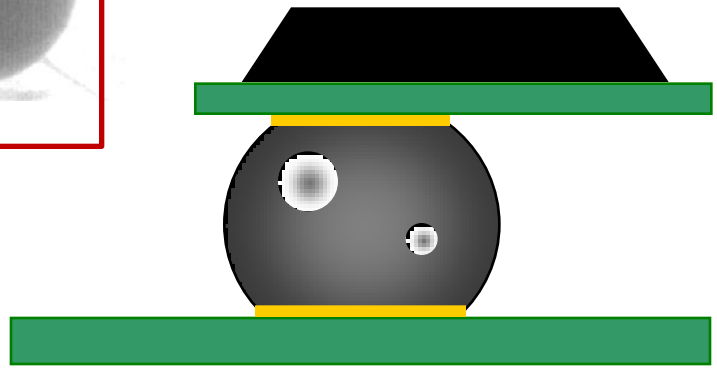
Voiding

- **Contrary effects - BGA versus BTC solder joints**
  - BTC/area solder joints require **good** wetting to achieve low voiding
    BGA solder joints show better results with **bad** wetting
  - BTC/area solder joints usually have undefined void shapes
    BGA solder joints usually have spherical pores







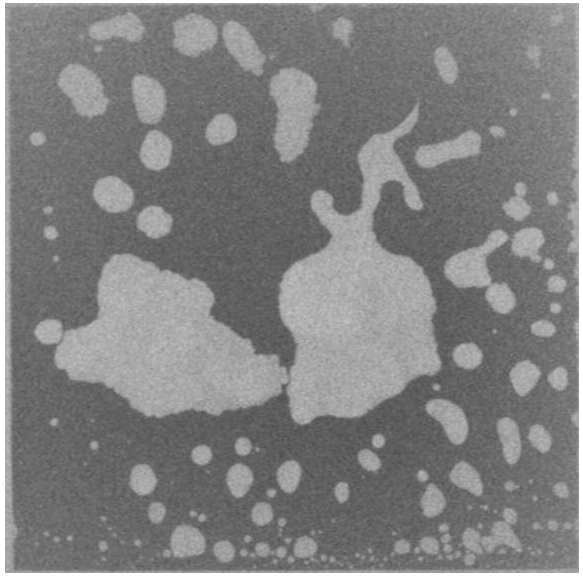


Voiding

- **Void shape**
  - Influence of roughness on the wetting angle Θ

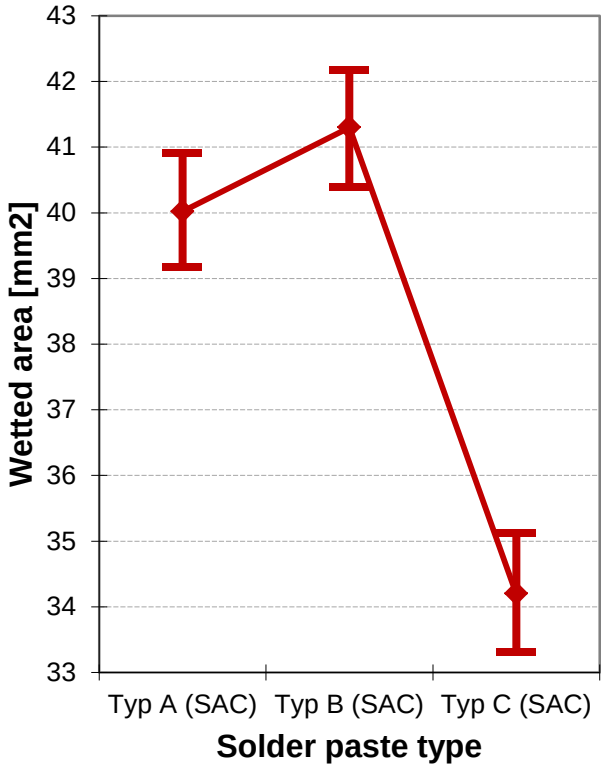
$$\tan\alpha = \frac{R_a}{\lambda}\cdot\pi$$

$$\theta_a = \theta + \alpha, \qquad \theta_r = \theta - \alpha$$

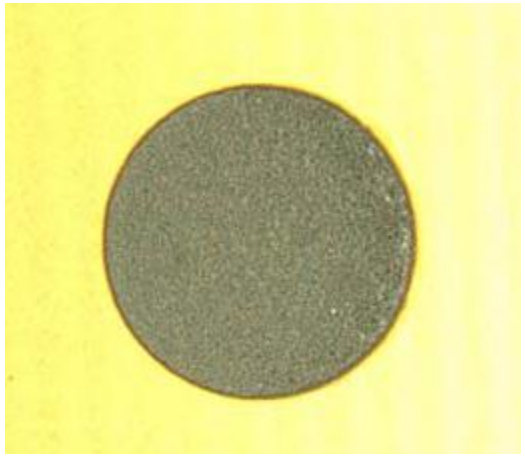


Voiding

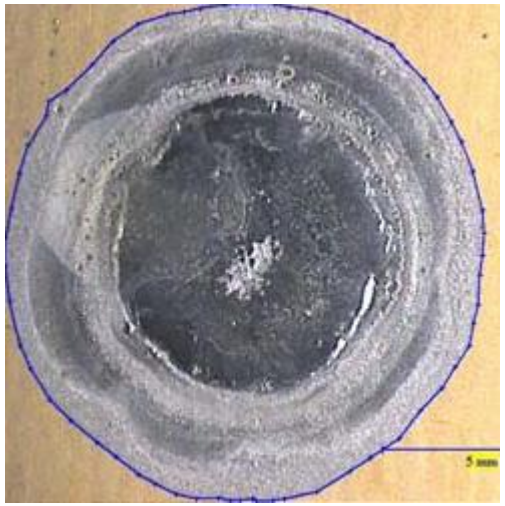
- **Influence of solder paste and wetting**
  - Solder spreading



Paste deposit



Wetted area

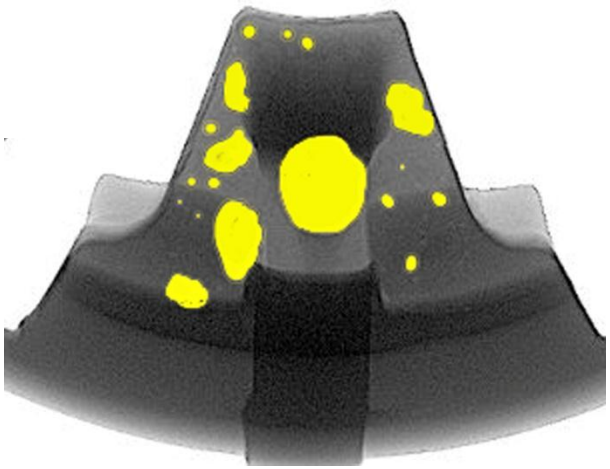


Source: Heinz Wohlrabe,VoidExpert Database, 2013

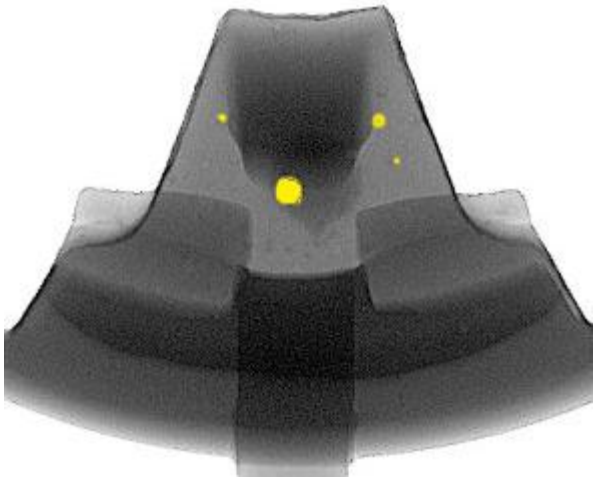
Voiding

- **Influence of wetting**
  - Copper contact, SAC solder

As delivered, no cleaning



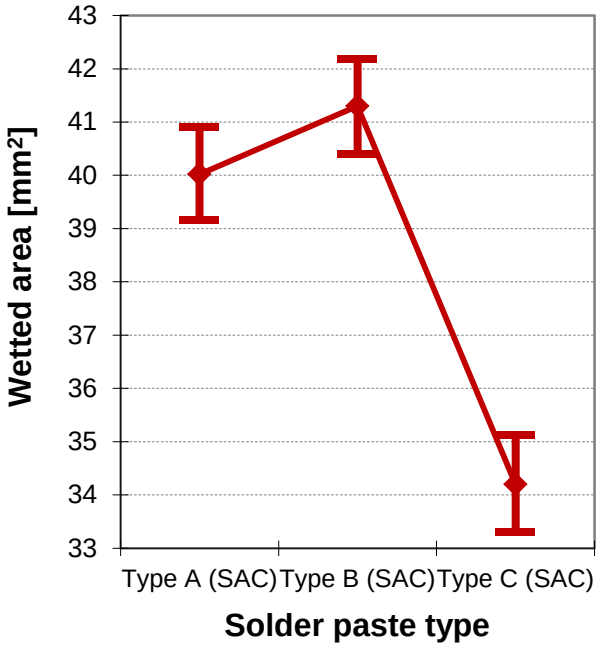
Chemical cleaning before soldering



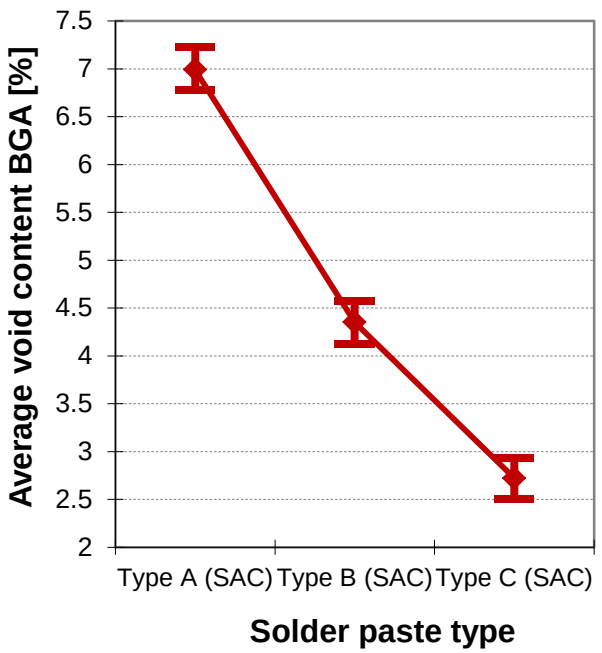
Voiding

- **Influence of solder paste and wetting**
  - Contrary effects, BGA vs. Si-Chip solder joints

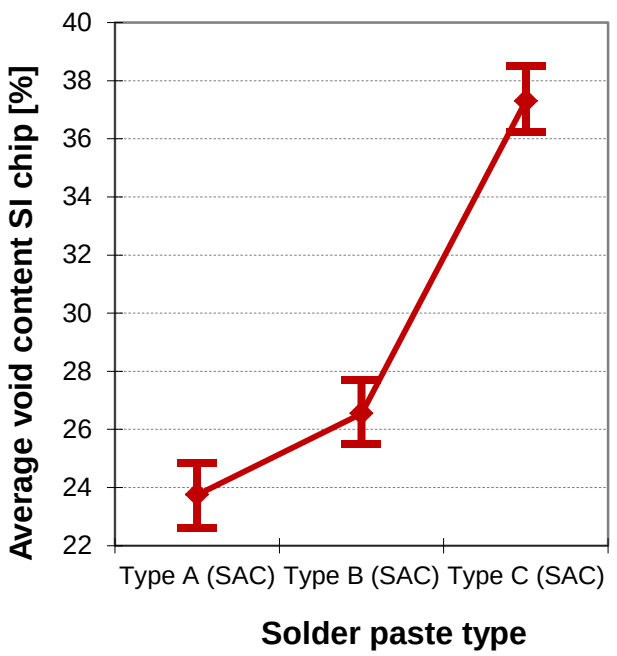
Solder spreading



BGA 176



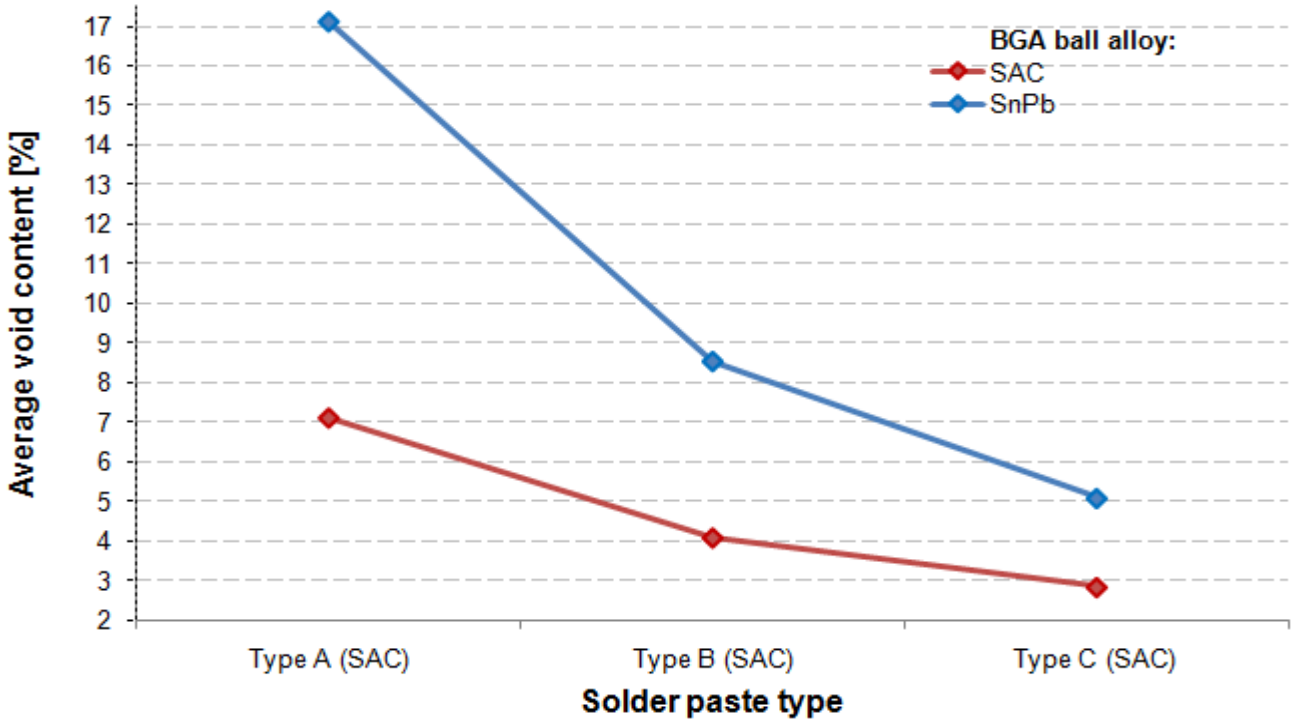
Si Chip



Source: Heinz Wohlrabe,VoidExpert Database, 2013

Voiding

- **Influence of alloy**
  - SAC solder paste, BGA: SnPb balls vs. SAC balls

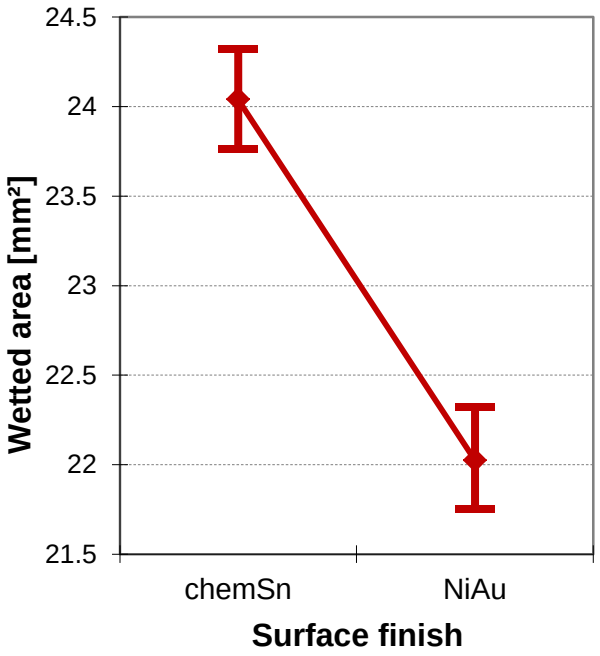


Source: Heinz Wohlrabe,VoidExpert Database, 2013

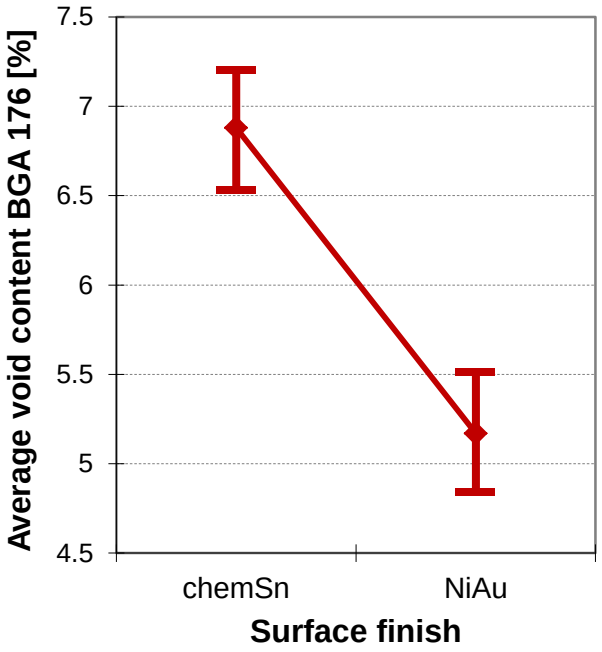
Voiding

- **Influence of surface finish and wetting**
  - Contrary effects, BGA vs. QFN solder joints

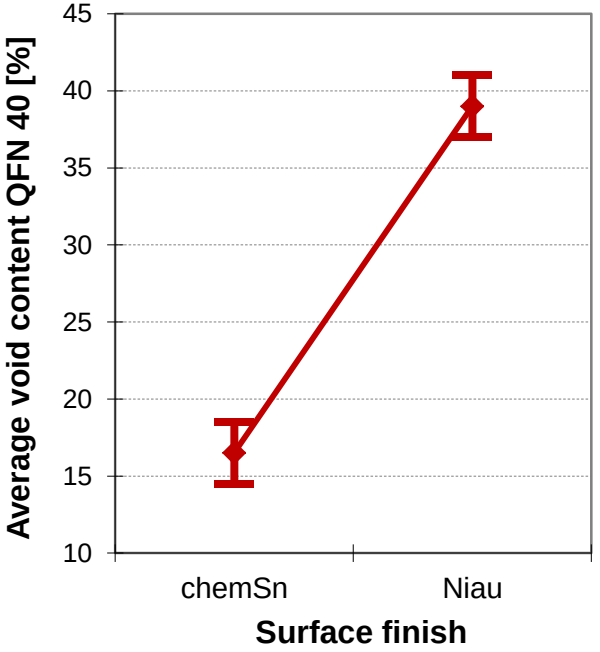
Solder spreading



BGA 176



QFN 40

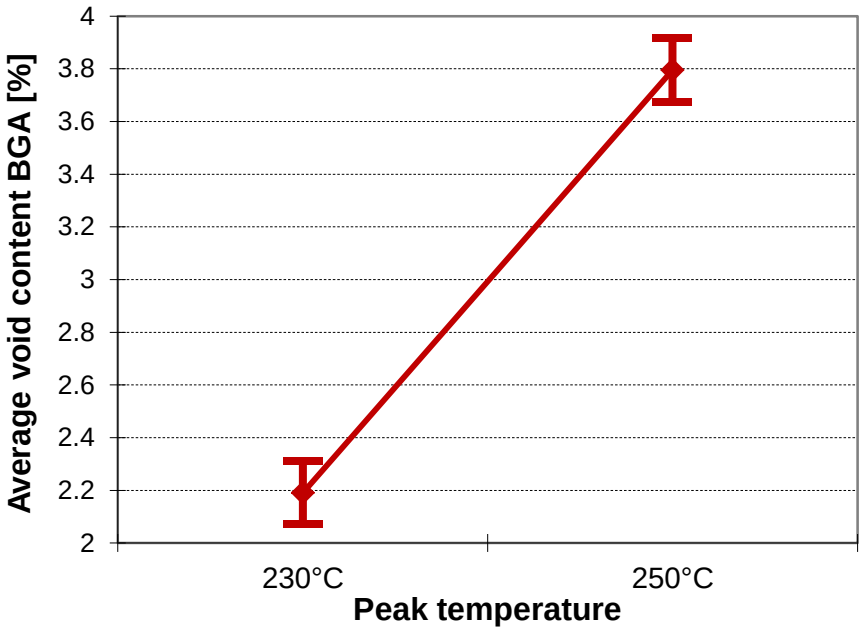


Source: Heinz Wohlrabe,VoidExpert Database, 2013

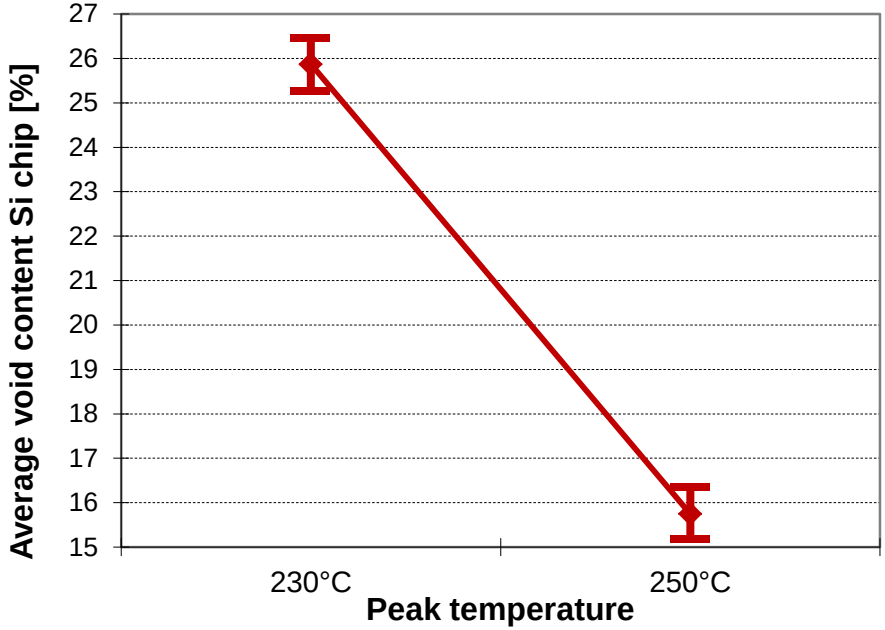
Voiding

- **Influence of peak temperature**
  - Contrary effects, BGA vs. Si chip soldering joints

BGA 196



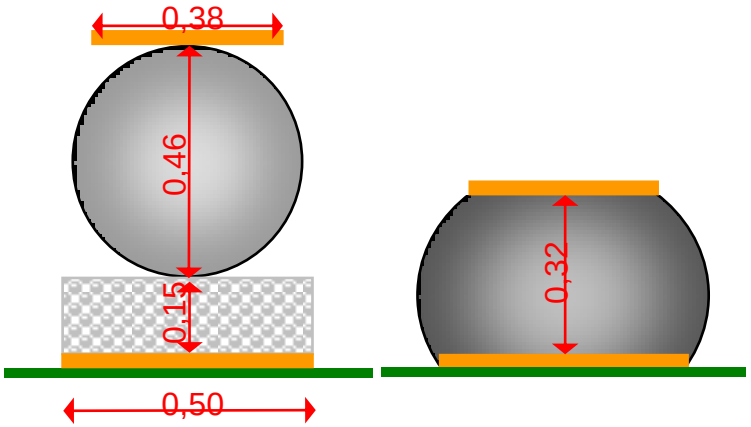
Si-Chip



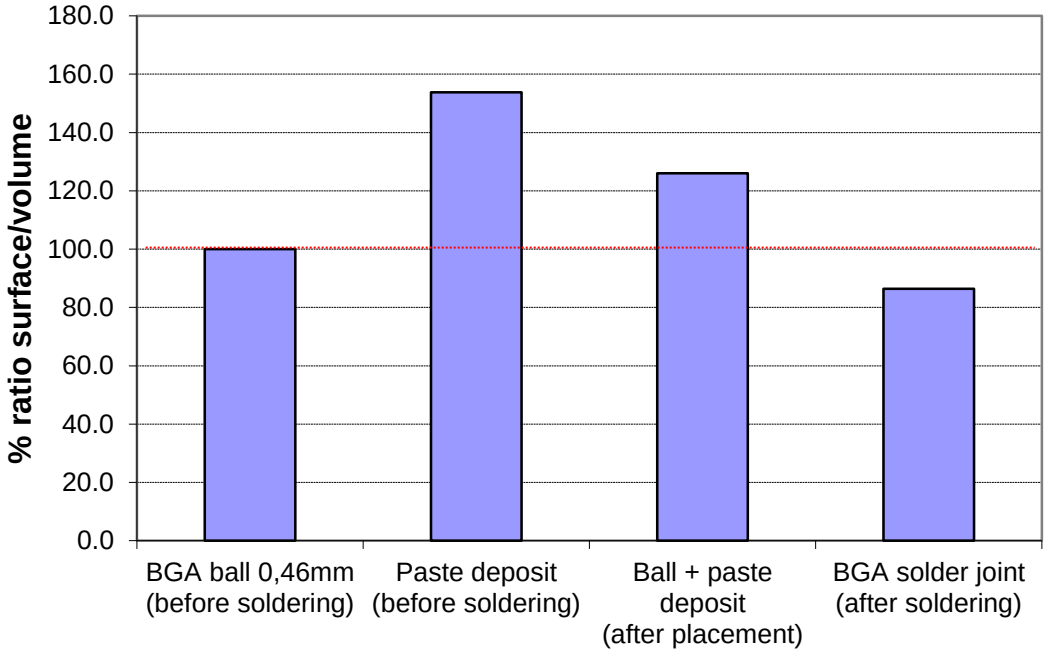
Source: Heinz Wohlrabe,VoidExpert Database, 2013

Voiding

- **Influence of geometry**
  - BGA solder joint, geometric conditions
    Total solder volume: 0,065 mm³

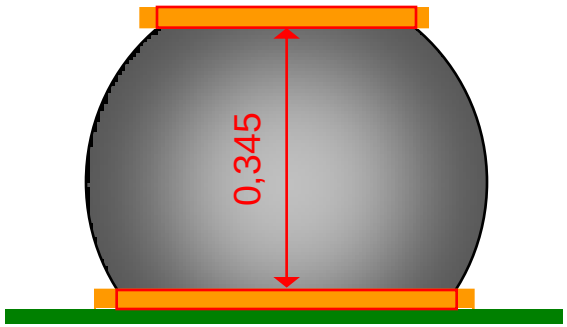


Before placement After soldering

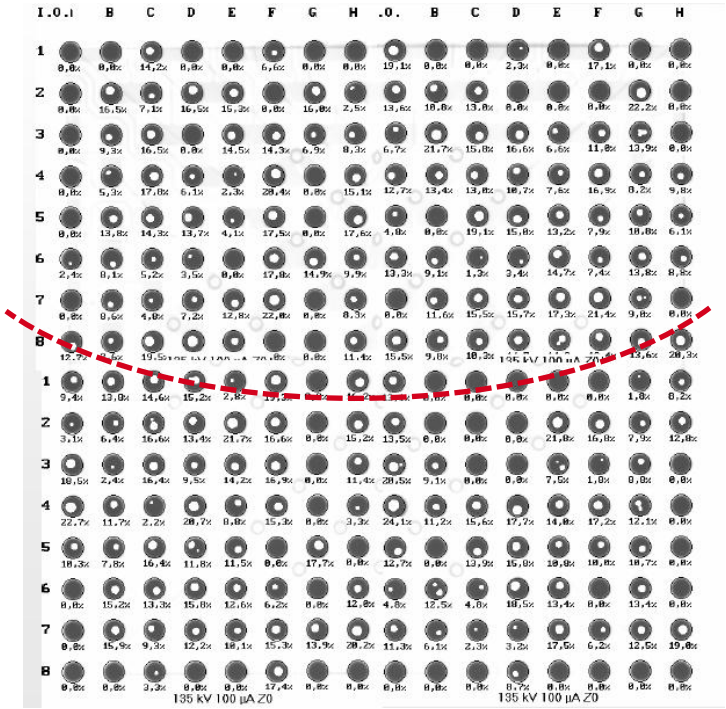


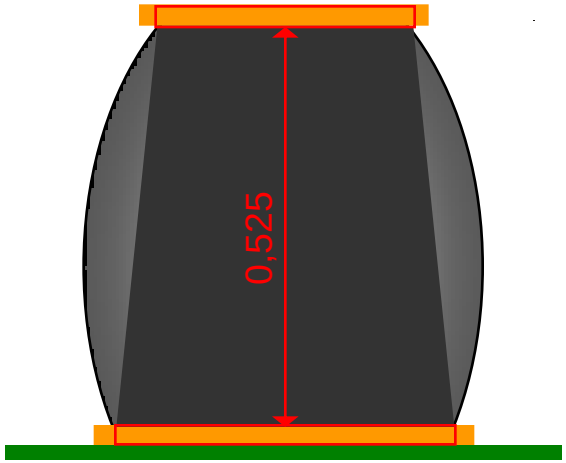
Voiding

- **Influence of geometry**
  - Twisting/warpage of BGA solder joints



After ball collapse (~ 110 µm)





After warpage of 180 µm

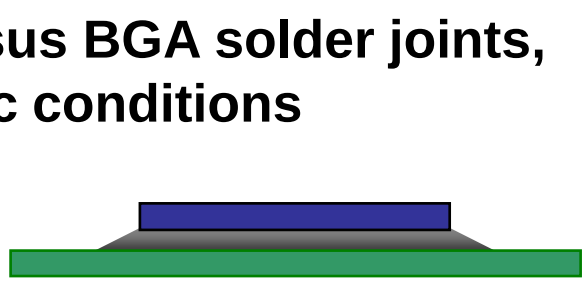
Source: Heinz Wohlrabe,VoidExpert Database, 2013

Voiding

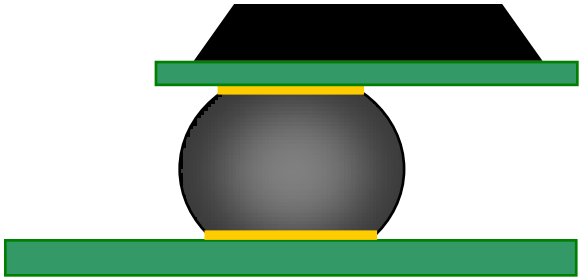
- **Influence of geometry**
  - Twisting/warpage of BGA solder joints

Voiding

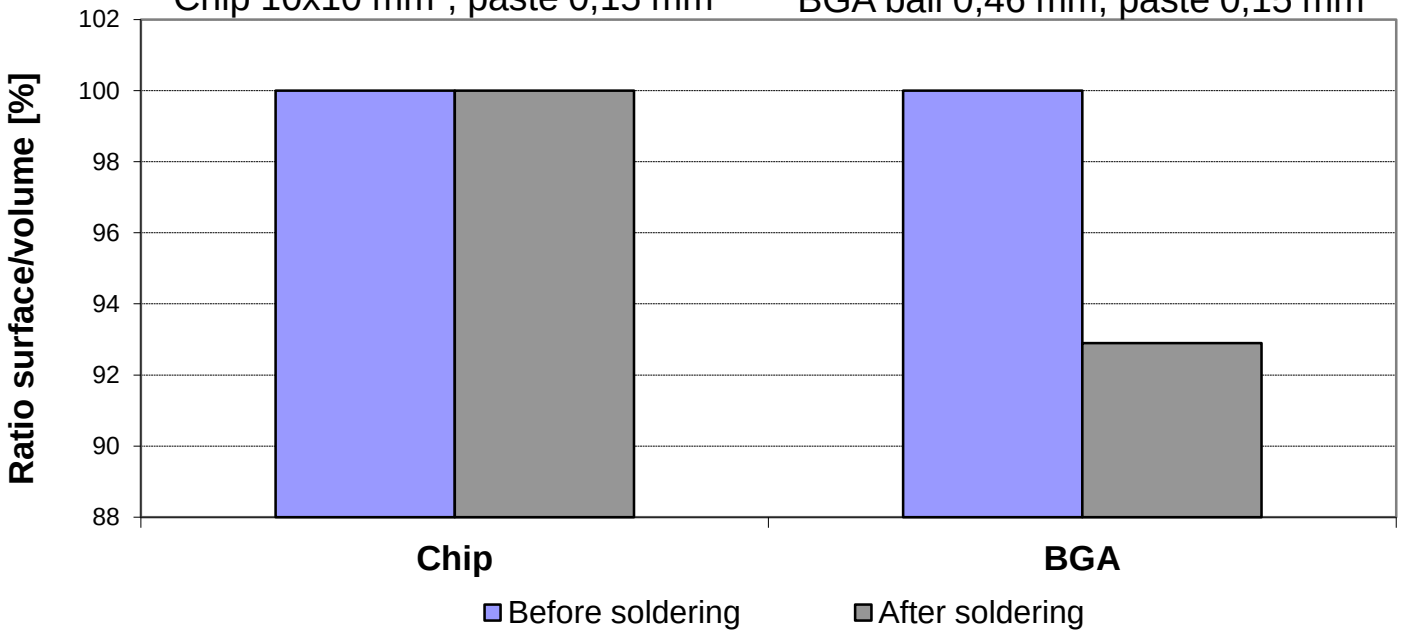
- **Chip versus BGA solder joints, geometric conditions**



Chip 10x10 mm², paste 0,15 mm

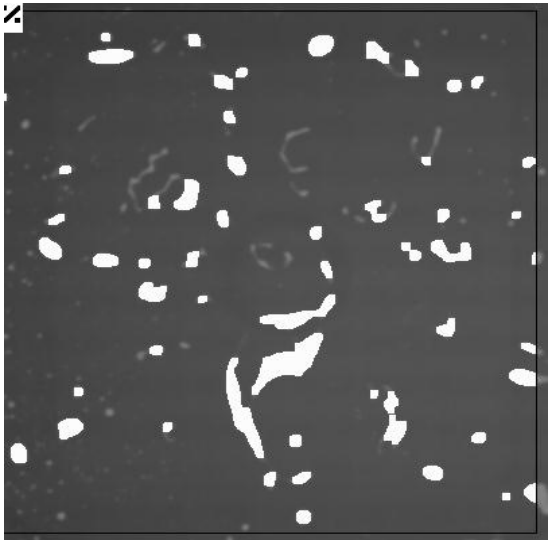


BGA ball 0,46 mm, paste 0,15 mm

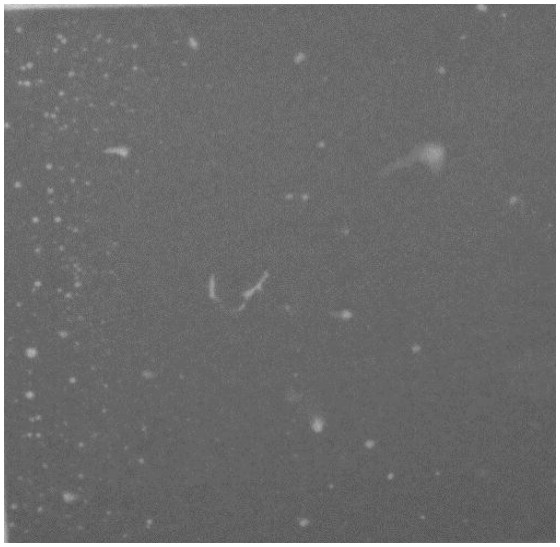


Voiding

- **Influence of of gap thickness (solder paste thickness)**
  - Si-Chip, paste: SnAgCu, vacuum condensation soldering



Paste thickness: 125 µm



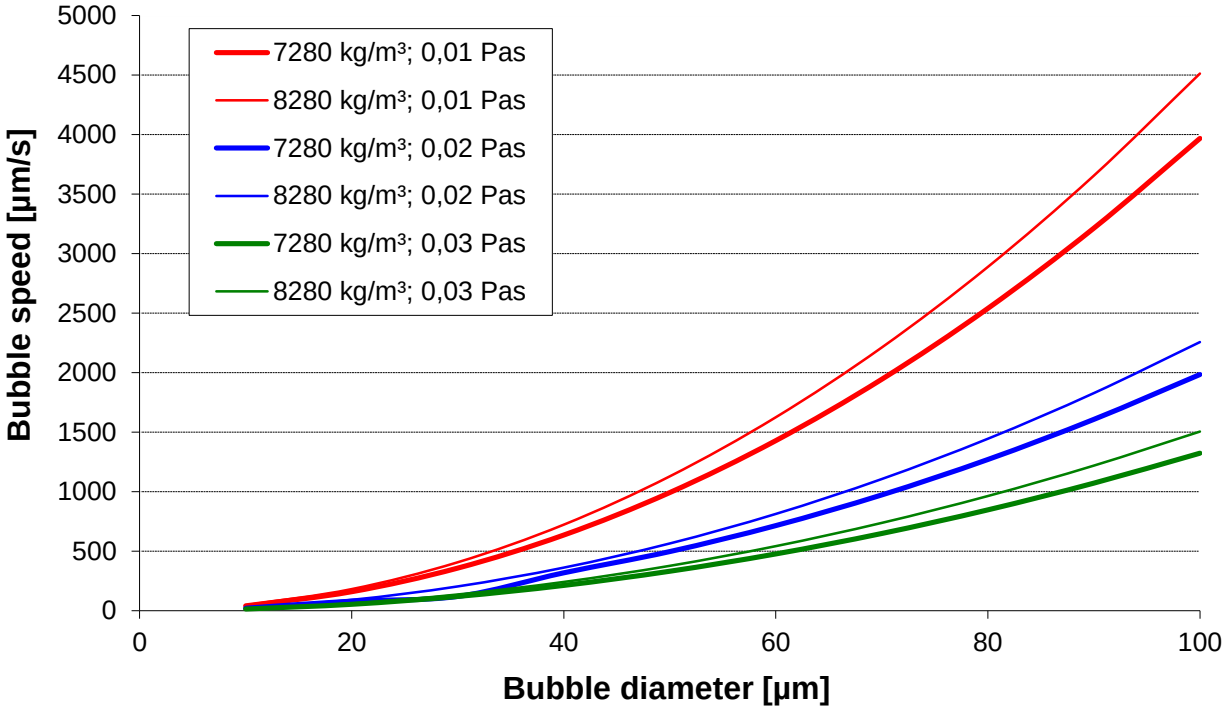
Paste thickness: 180 µm

Source: Heinz Wohlrabe,VoidExpert Database, 2013

Voiding

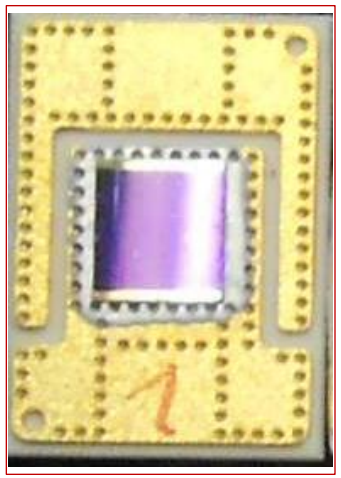
- **Bubbles' rate of ascent**
  - Calculated according to viscosity data from Fraunhofer IZM Berlin

$$v_B = \frac{1}{18} \cdot \frac{(\rho_B - \rho_L) \cdot d^2 \cdot g}{\eta}$$

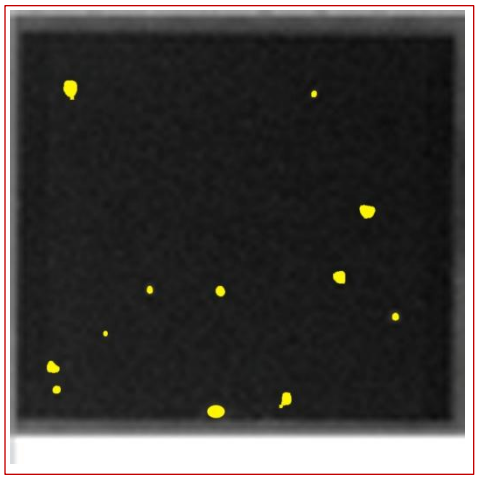


Voiding

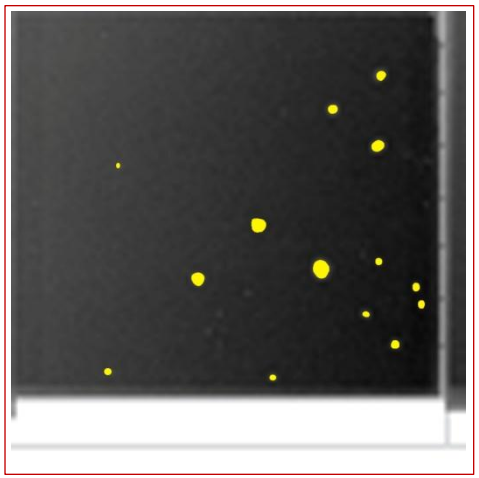
- **Influence of vacuum (low pressure level)**
  - No significant improvement during longer vacuum dwell time
    0,23 % voids



10 mbar @ 10 s



100 mbar @ 100 s



Thank you!

- **Thanks to our colleagues of the working group:**
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