Implications of laser-doping parameters and contact opening size on contact resistivity

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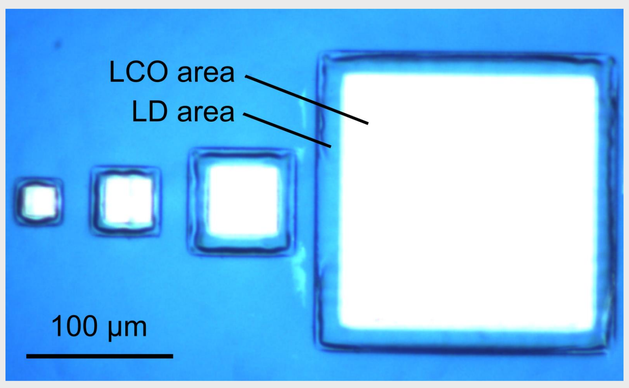
Derivation of an ohmic local contact analysis (OLCA) to determine the contact resistivity of localized contacts with simple sample structure

Motivation

- **Localized contacts**
  - Important for **advanced cell structures**
  - Cannot be measured by transfer length method (**TLM**)
- Alternative method to determine contact resistivity ρ_C: **OLCA**

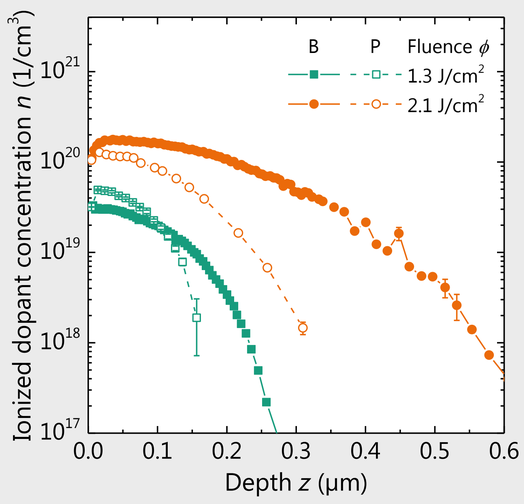
Sample fabrication

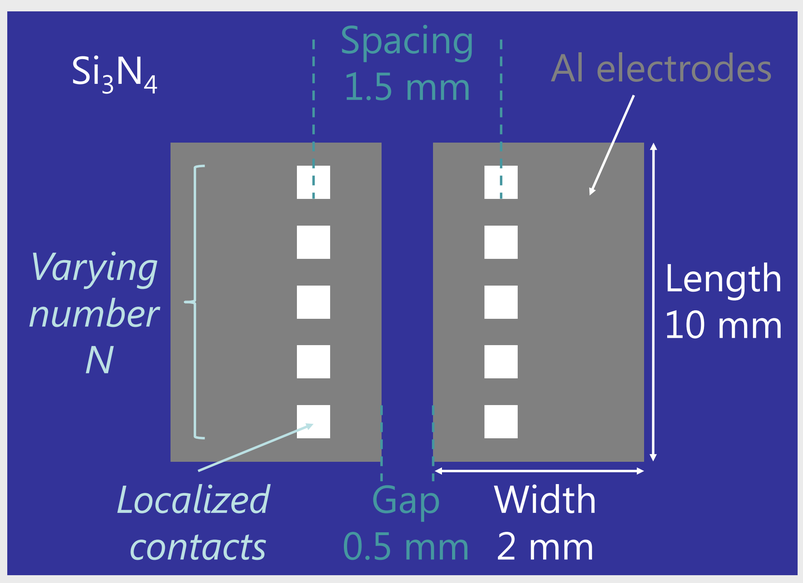
- **Localized contacts** with laser processing (Excimer laser)
  - Laser doping (**LD**): varying **fluence** and **size**
  - Laser contact opening (**LCO**): adjusting size
  - Boron (**B**) and Phosphorus (**P**) dopant sources



Microscope image illustrating the variation of laser-doping size (variable aperture) after laser-contact opening confined to a region smaller than the laser-doped areas.

- **Ohmic** sample structure:
  Localized contact polarity = **base** polarity
- Large-area laser doping (stitched spots) to measure
  - **Sheet resistivity** $R_\square$ (4PP)
  - **Dopant profile** $n(z)$ (ECV)
- **LPCVD** Si_3N_4 for surface passivation
- **PVD** aluminium for **electrode** metallization

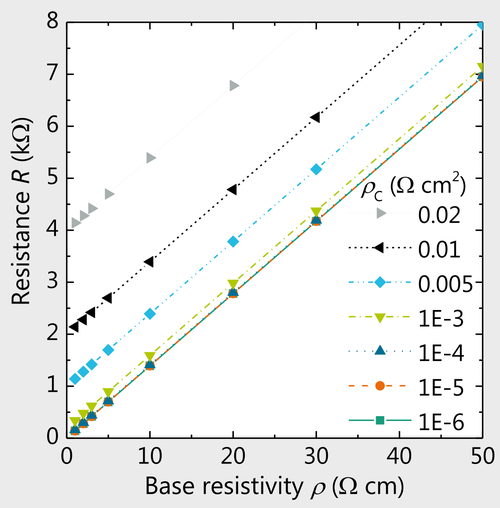


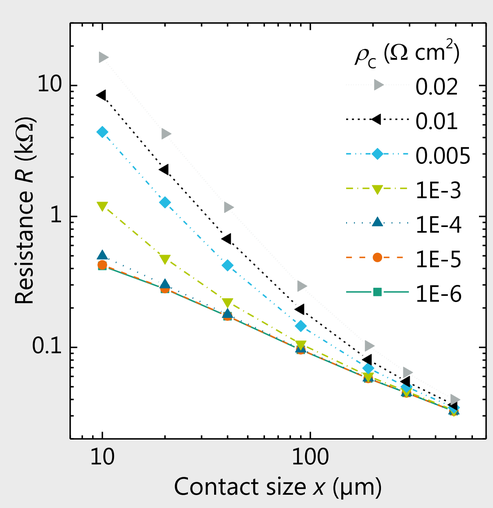


Sketch of the sample structure: Localized contacts are placed collinearly and equidistant under electrodes with defined spacing.

Numerical simulation

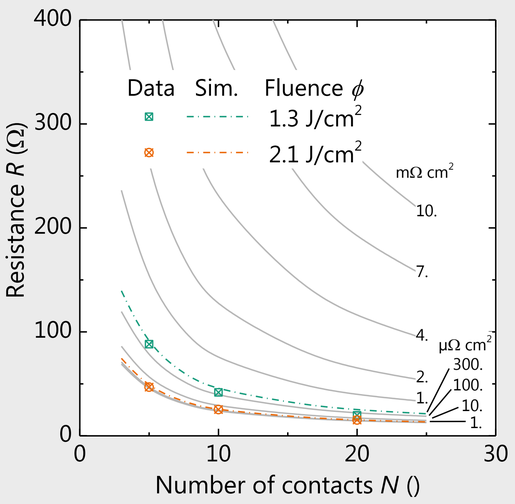
- **Quokka 3** simulation of ohmic structures
- Parameter sweeps to determine **critical parameters** ρ, x



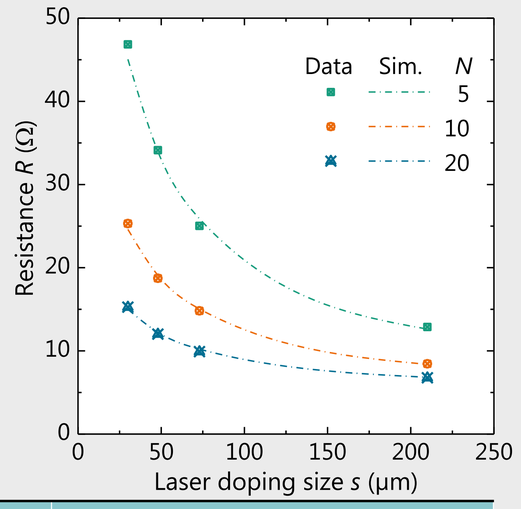


Contact resistivity

1. Initial set of **simulations**
2. Compare *R(N)* **measurements** and simulation results
3. Perform additional **simulations** in relevant range



- **Consistency** check
  - Determine ρ_C only for spot size s = 30 µm
  - Simulate **all** other spot sizes
  - Plot measurement (**data**) and simulation (**no fit**)



After forming gas anneal, 300 °C:

	Boron		Phosphorus	
Fluence ϕ	**$R_\square$**	**ρ_C**	**$R_\square$**	**ρ_C**
(J/cm²)	(Ω/□)	(mΩ cm²)	(Ω/□)	(mΩ cm²)
1.3	97 ± 9	0.42	186 ± 20	0.35
2.1	36 ± 4	0.04	60 ± 7	0.07

Conclusion

- **OLCA** method was **successfully** applied
- **Localized contacts** with **PVD Al** show **low** ρ_C < 0.1 mΩ cm²
  - Comparable to similar large area dopings (TLM)
- **Method** can be applied to **other fabrication methods**, such as screen-printed metallization

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