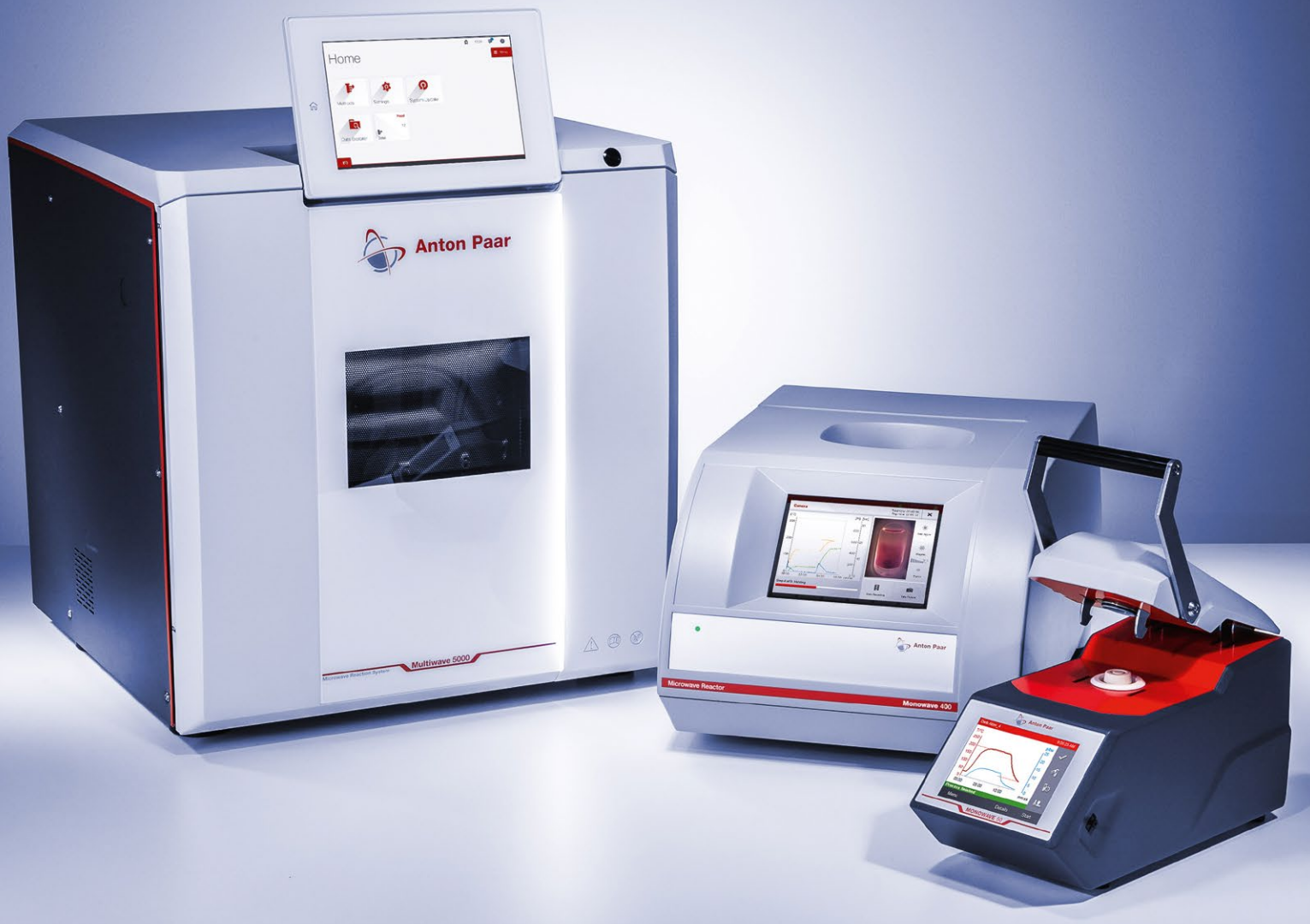
Anton Paar

Synthesis reactors



Synthesis reactors for research, development, and education

Monowave microwave reactors: The leaders in the lab

Anton Paar's high-performance Monowave microwave reactors – designed for small- to medium-scale microwave synthesis – boost productivity and enhance product purity across all applications, in research and development laboratories. Their lab footprint is small, but their impact is big: They offer high-speed, closed-vessel microwave chemistry at temperatures of up to 300 °C and pressures of up to 30 bar. Queue and process up to 24 vials of different sizes automatically, with reaction times up to 100 h. Shorten your workflow through real-time observation with a built-in digital camera, and VNC remote control. Microwave reactors of the Monowave 400 series are fully 21 CFR part 11-compliant. And, for the first time ever, you can perform flawless in situ reaction monitoring of microwave reactions with Monowave 400 R, and its integrated Raman fiber optic probe.

Rapid, uniform heating is guaranteed by 850 W unpulsed microwave power automatically adjusted for the sample, and powerful stirring up to 1200 rpm. Precise internal fiber-optic ruby-thermometer temperature measurement permits quick adjustment responses, for successful synthesis involving highly exothermic reactions.

The result: Powerful increases, across the board, to yield and purity.

Monowave 200 Monowave 400 Monowave 450

Vials for any application

- Vials for reaction scales between 0.5 mL and 20 mL, with tool-free handling
- Wide-neck vials for bulky samples and extractions (only available for Monowave 400 and Monowave 450)
- Silicon carbide vials for efficient heating of all solvents, and processing of chemicals not suitable for glass vials (see Fig. 1)

Precise internal temperature measurement

- Simultaneous internal temperature measurement with the fiber-optic ruby thermometer (optional accessory) for accurate control of highly exothermic reactions
- Improved traceability and reproducibility
- Essential for transfer and scale-up of reaction protocols

Fig. 1: Reaction vials

Fig. 2: Reaction observation with integrated camera

Monowave 400 Monowave 450

Setting the standard for demanding chemical reactions

- Max. temp.: 300 °C; Max. pressure: 30 bar
- Reaction time: up to 100 h
- Remote control via VNC
- 21 CFR part 11-compliant

Built-in digital camera – for real-time observation of your reaction

- Image and video recording with integrated digital camera
- Observation of color changes and precipitation and dissolution of substrates, stirring efficiency (see Fig. 2)

Monowave 450

Automation, for increased productivity

- Autosampler MAS 24 accommodates up to 24 vials of different sizes
- Automatic queueing and processing
- Small footprint – no extra lab space required, because Autosampler MAS 24 sits right on top of the instrument

Monowave 200

A strong foundation – for education and fundamental research

- High-speed, closed-vessel microwave chemistry at temperatures of up to 260 °C and pressures of up to 20 bar
- Operational limits extension, supplementary features, tools and accessories accessible with a software upgrade

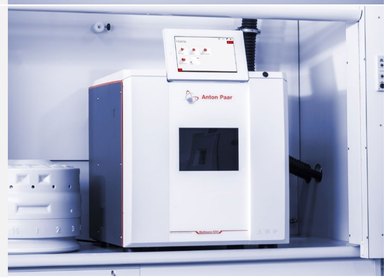
Synthesis reactor systems for any application

In situ reaction monitoring

Monowave 400 R & Cora 5001: Joint forces, rapid results
Coupling Monowave 400 R to Cora 5001 with a modified non-metallic 785 nm Raman fiber-optic probe makes possible, for the first time, flawless in situ reaction monitoring of microwave reactions.
Identify reaction intermediates, investigate reaction kinetics, characterize products and conduct endpoint determination directly during the experiment.
A protective interlock connection makes the combination a safe Laser Class 1 setup.

Multimode microwave reactors

Multiwave 5000: One system, endless possibilities
From high-performance chemistry suited for materials synthesis and nanotechnology, high-throughput screening and compound library generation, to parallel scale-up and solvent extraction, there's a configuration fit for any task. The Multiwave 5000 microwave reaction system provides unmatched operational parameters of up to 300 °C and 80 bar, and allows performance of up to 96 chemical reactions in parallel.

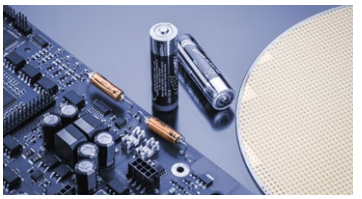


Conventionally heated synthesis reactor

Monowave 50: Conventional heating with microwave speed
Monowave 50 bridges the gap between affordable but difficult to operate synthesis autoclaves, and microwave reactors. It offers great convenience and strong performances of up to 250°C and 20 bar.
With its small dimensions and minimal installation requirements, it fits into the tightest lab spaces - even inside a glovebox. Reusable consumables and a low initial investment mean this synthesis reactor is both environmentally and economically friendly.

Anton Paar's solutions for your application

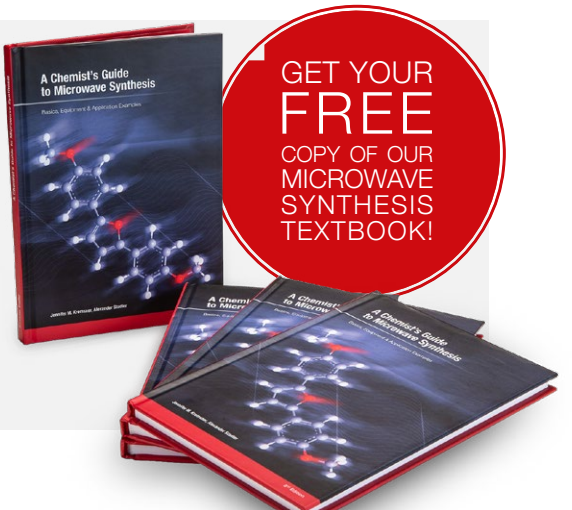
Publication title	"Parallel Microwave Chemistry in Silicon Carbide Microtiter Platforms: A Review"	"Synthesis of a Tetrazine-Quaterthiophene Copolymer and its optical, structural and photovoltaic properties"	"Microwave synthesis of high-quality and uniform 4 nm $ZnFe_2O_4$ nanocrystals for application in energy storage and nanomagnetics"
Instrument	Multiwave 5000 with Rotor 4x24MG5	Monowave 50	Monowave 400
Samples	Active pharmaceutical ingredients (APIs)	Conjugated donor-acceptor polymers for organic photovoltaics (OPV)	Magnetic nanocrystals with a narrow size distribution
Solution	Homogeneous temperature distribution and fast, reliable heating rates allow for efficient high-throughput parallel synthesis of compound libraries in SiC plates in Multiwave 5000.	Conventional heating with microwave-like specifications in Monowave 50. The reactor can be used inside a glove box.	Method development in Monowave 400 and direct scale-up in Masterwave BTR made possible by internal temperature monitoring.
Reference	C. O. Kappe, M. Damm, Mol. Divers. 2012, 16, 5 - 25	A.-C. Knall et al., J. Mater. Sci. 2019, 54, 10065-10076	C. Suchomski et al., Beilstein J. Nanotechnol. 2016, 7, 1350-1360



Publication title	"Synthesis of EDOT-containing polythiophenes and their properties in relation to the composition ratio of EDOT"	"Reversible Sodium and Lithium Insertion in Iron Fluoride Perovskites"	"High-Capacity, Aliovalently Doped Olivine $LiMn_{1-3x/2}V_x\square_{x/2}PO_4$ Cathodes without Carbon Coating"
Instrument	Monowave 400	Monowave 400	Multiwave 5000 with Rotor 8
Samples	Semiconducting polythiophenes	$NaFeF_3$ Perovskite Nanoparticles from Rutile Precursors	Solvothermal synthesis of $LiFePO_4$ Nanocomposite Cathodes for Li-Ion Batteries
Solution	Direct CH-Arylation Polycondensation in microwave reactors makes polymerizations easier while avoiding potentially toxic reagents.	FeF_2 precursors were converted into perovskites in a microwave-assisted reaction under inert conditons.	Rotor 8 for highest temperature and pressure specifications with real-time pressure monitoring of all vessels.
Reference	I. Imae et al., RSC Adv. 2015, 5, 84694-84702	A. Martin et al. Adv. Funct. Mater. 2018, 1802057	A. Gutierrez et al., Chem. Mater. 2014, 26, 3018-3026

Still looking for your application?
Discover the world of microwave synthesis.
www.anton-paar.com/synthesis

Find the right reaction conditions in our application database. Explore our collection of over 2000 chemical reactions that have been successfully performed in our reactors.
For a quick start with sealed-vessel synthesis, use our protocol converter and find the right reactor with the help of our configuration finder.



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