A multi-sample diffusion cell for noble gas analysis

JEREMY HOURIGAN[1], MARTY GROVE[2] AND EMILY PETERMAN[3]

[1]Earth and Planetary Sciences, UC Santa Cruz, 1156 High St, Santa Cruz, CA 95064
[2]Geological and Environmental Sciences, Stanford University, Stanford CA 94305
[3] Earth and Oceanographic Science, Bowdoin College, Brunswick, ME 04011
* correspondence: hourigan@ucsc.edu

This contribution describes the characteristics and performance of a diode laser noble gas microfurnace system developed at UC Santa Cruz and modified for the Stanford Noble Gas Laboratory. Two modes of microfurnace operation for metal-encapsulated samples are outlined: (1) visible-light regulated, "near saturation pyrometry"; and (2) thermocouple regulated, high-precision, step-heating. Mode 1 is appropriate for routine extraction of radiogenic ^{4}He for (U-Th)/He thermochronometry. Measurements performed on single-grain aliquots of apatite and zircon yield consistent and accurate (U-Th)/He dates on laboratory standards, indicating that the laser achieves quantitative extraction without devolatilizing U, Th and Sm. Mode 2 has great potential for a wide variety of noble gas applications including helium diffusion experiments and ^{40}Ar/^{39}Ar K-feldspar multi-diffusion domain analysis. Mode 2 uses a proportional, integral and derivative (PID) process temperature controller and feedback from a chromel-alumel thermocouple to achieve better than ~ ± 1.0°C precision for setpoint temperatures from 50°C to 1150°C with < 3 second lag times between 50°C setpoint changes. Helium diffusion data presented for monazite standard 554 agree well with published values.

Details regarding system design and controlling software are provided to aid construction of similar systems in other laboratories.