Nitric Oxide Reactor for Conjugating Nitric Oxide to Polymeric Materials

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TCoE

Abstract

The surfaces of blood contacting medical devices promote blood clot formation which can cause life-threatening complications including deep vein thrombosis and embolism in the lungs/heart/brain. As current anti-fouling surface modifications alone haven't solved this problem, alternate approaches including optimized anti-platelet nitric oxide (NO) release for clot control are needed. The objectives of this study were to build a NO reactor, charge medical grade polydimethylsiloxane (PDMS) polymer with NO using the reactor, and evaluate NO release from PDMS with a NO analyzer. Physiological level of NO release from PDMS was achieved for weeks and data for 15 days release is presented.

Methods and Materials

1. NO reactor was built using stainless steel pipes, connectors, valves, pressure gauges, and a reaction vessel.
2. A system leak test was conducted by pressurization with argon gas at reactor operating pressures.
3. A NO was scrubber was added to trap all exhaust NO from reactor.
4. PDMS polymers impregnated with additives was synthesized and then charged by placing them into NO reactor vessel to facilitate conjugation of NO to embedded additives.
5. NO release from polymer was characterized by chemiluminescence using a GE 280i nitric oxide analyzer.
6. Conjugation of NO to PDMS reaction is shown in **Figure 1**.

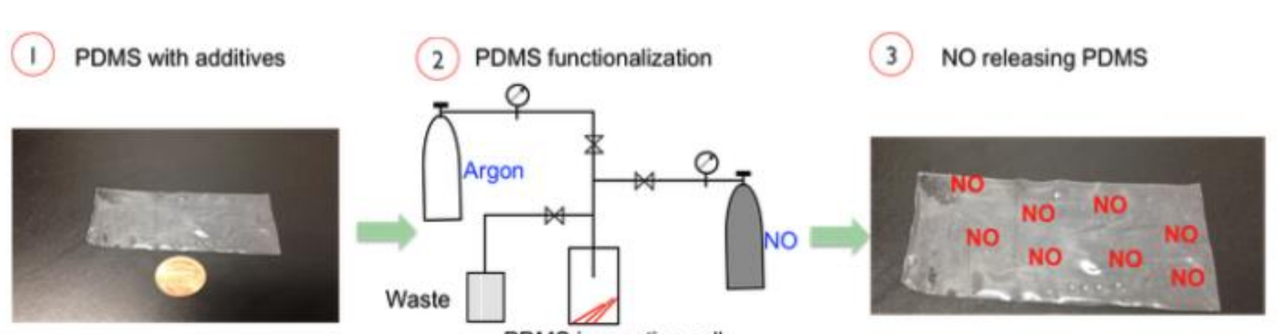

Figure 1: Conjugation process

Results

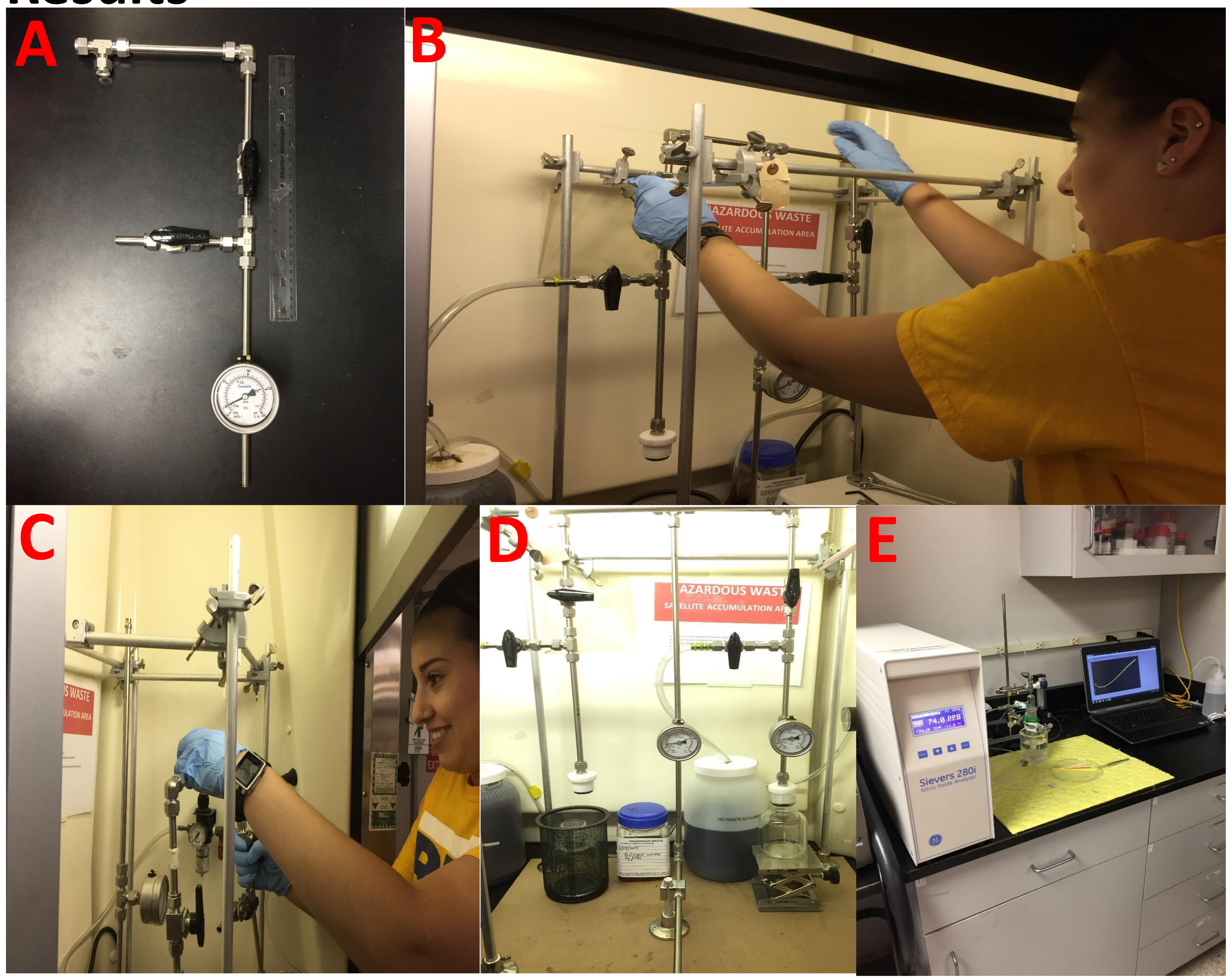

Figure 2: Arm for reactor A. Installation of arm under the hood B,C. Final product of arm D. Testing samples using the NOA E.

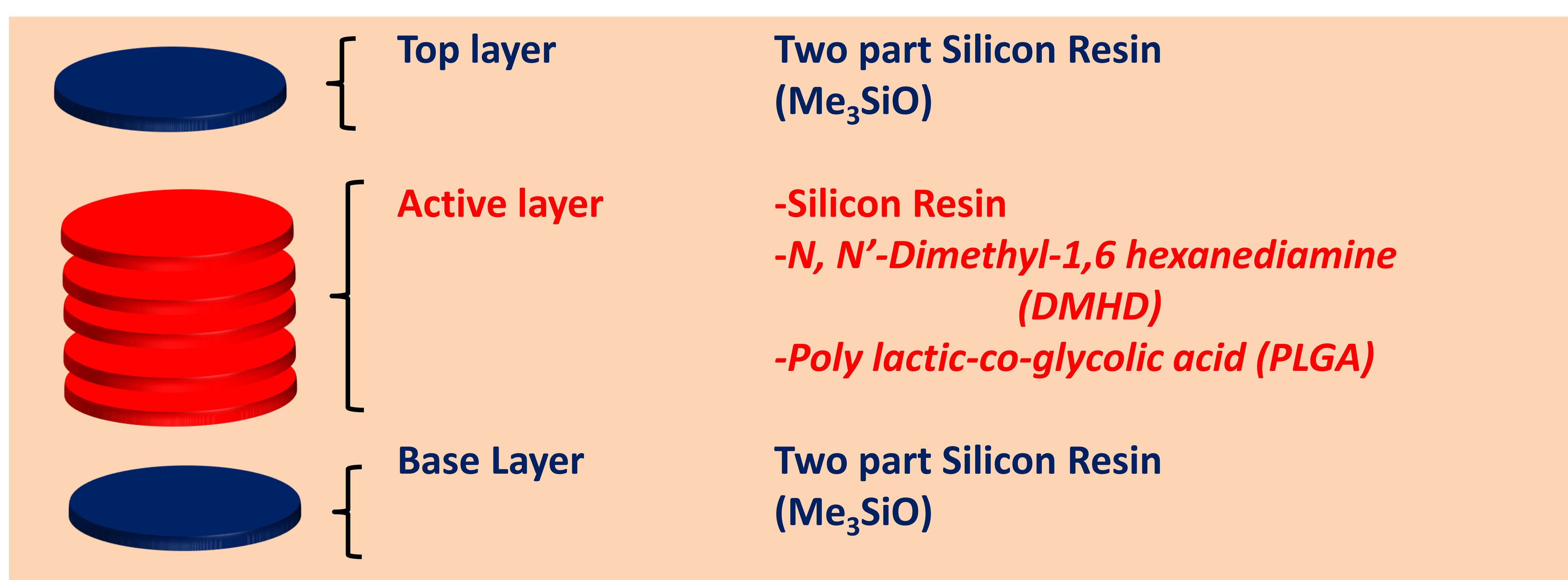

Figure 3: Composition of modified PDMS before charging in the nitric oxide reactor. Amounts of *N*,*N*'-Dimethyl-1,6-hexanediamine (DMHD) additive varied between 5%, 15% and 25%.

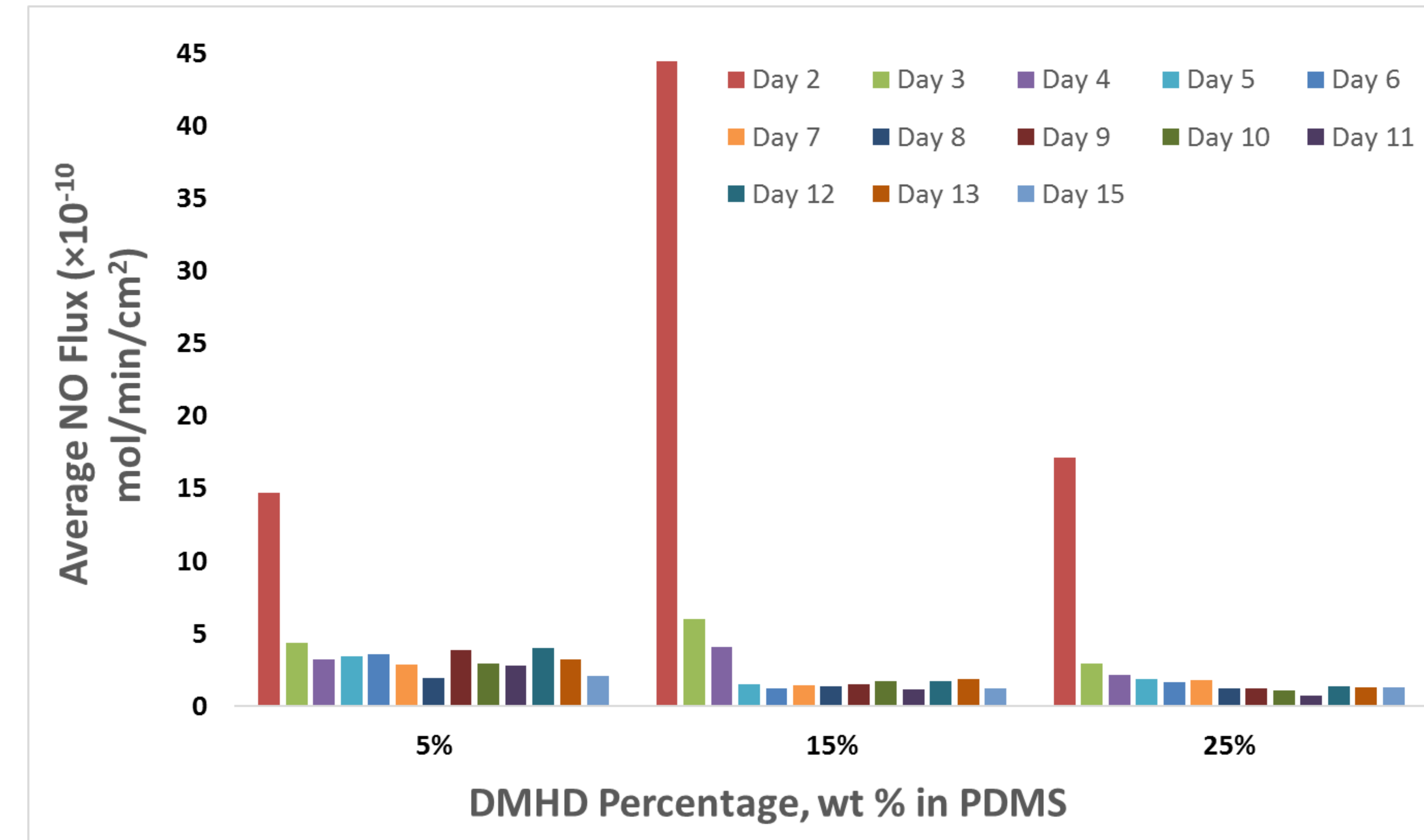

Fig. 4 Average Nitric Oxide Flux from samples with 5 layers over 15 days

Discussion

As shown in figure 4, NO release was maintained over 15 days from all samples (PDMS w/5, 15, and 25 wt% DMHD). PDMS w/25 wt% DMHD released highest NO only on day 1 (not shown). Subsequent 3 days showed similar and higher releases from PDMS w/5 and 15 wt% DMHD. From days 5 to 15, release from PDMS w/5 wt% DMHD was highest followed by PDMS w/15 wt% and then w/25 wt% DMHD. In light of the fact low pH promotes NO release, our data suggest that increasing levels of free DMHD in the PDMS with NO release increase its pH which in turn limit the dissociation of NO from PDMS. Future work will examine pH dynamics on NO release and optimize material chemistry for longer-term (6 weeks) release.

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