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The fusion of material science, cyber-physical security and information science for next generation tools for treaty verification, safeguards and non-proliferation

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Arms controls treaties are vital for ensuring global security. A guiding principle for the development of these treaties is that they should be verifiable. Continuity-of-knowledge of the state of treaty-verifiable items must be maintained to ensure that they are not modified or swapped out in a manner inconsistent with the treaty. Verification of arms control treaties pose unique, multidisciplinary technical challenges. The challenges involve concerns related to cyber-physical security issues, maintaining knowledge barriers, distributed sensor networks, structural health monitoring, non-destructive evaluation, and sensing. It is often the case that treaty verification personnel only have limited time and physical access to treaty-accountable items. In many cases the treaty-accountable items spend the vast majority of the time under the control of parties that might have an interest in tampering with the treaty-accountable items. Current technologies for verifying treaties do not adequately address these challenges. This presentation will focus on the development of technologies that intimately combine material science with signal processing, machine learning, and cyber-physical security to candidate tools for the next generation of treaty verification. Specifically we fill focus on the development of a remotely readable, graphite-oxide tamper-evident seal and the potential for the use of the magnetic Barkhausen noise effect to establish unique fingerprints of nominally similar ferrous components. Both of these technologies combine material science with information science and security concepts. Undoubtedly other research opportunities exist for combining material science and information science to enable new technologies not only for treaty verification, but other commercial applications that require continuity-of-knowledge of the state of physical objects.

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