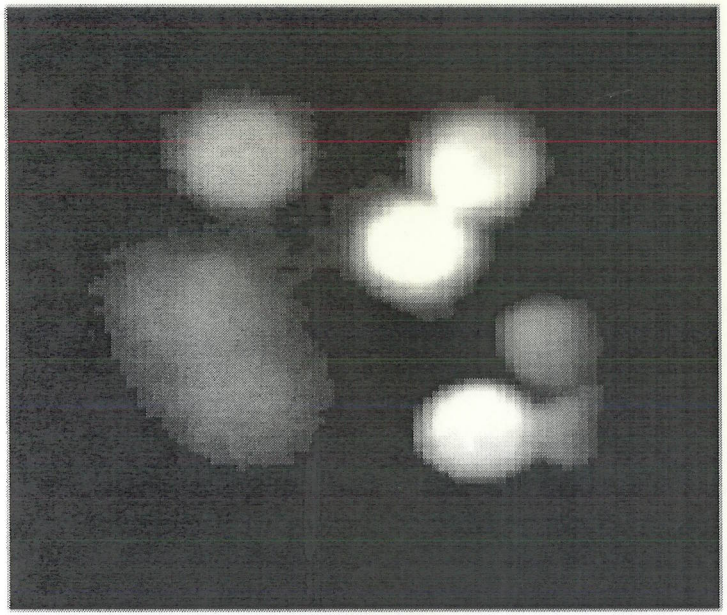
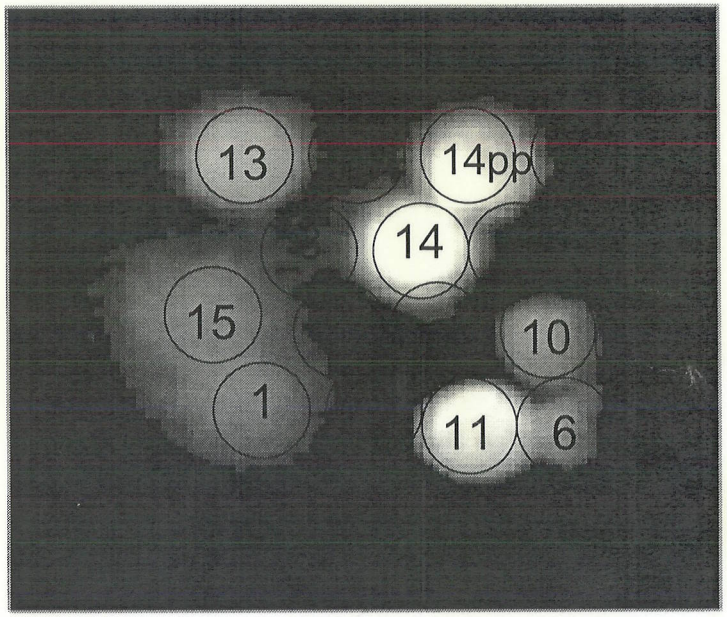
MRI probe materials

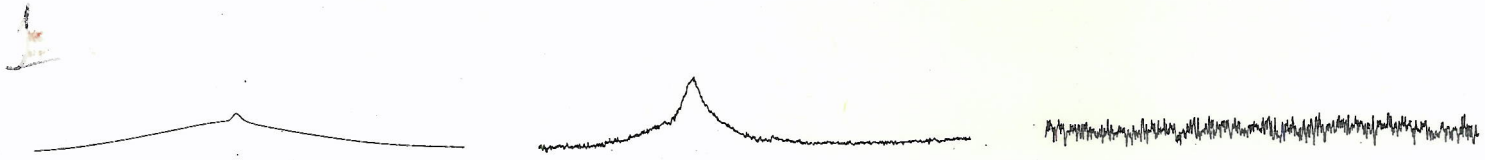




SWIFT, sw=64kHz,np/2=128, nv=4000, nt=16

Not recommended as MRI probe materials:
1(Acetal(POM)), 6(HIPS), 10(PVC/Acrilic), 11(Poliurethane,Thermost RIM), 13(PVC/Acrilic(white)), 14(PVC/Acrilic(blue)), 14pp(Polypropylene(white)), 15(RC 79D(yellow)

Acetal (polyoxymethylene copolymer)



PEEK (polyetheretherketone)

x16

Nylon 6/6 (polyimide)

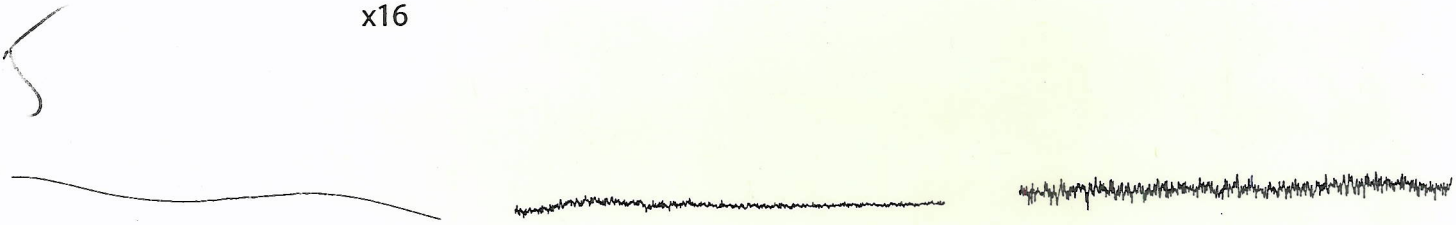
x16

Ultem (polyetherimide)

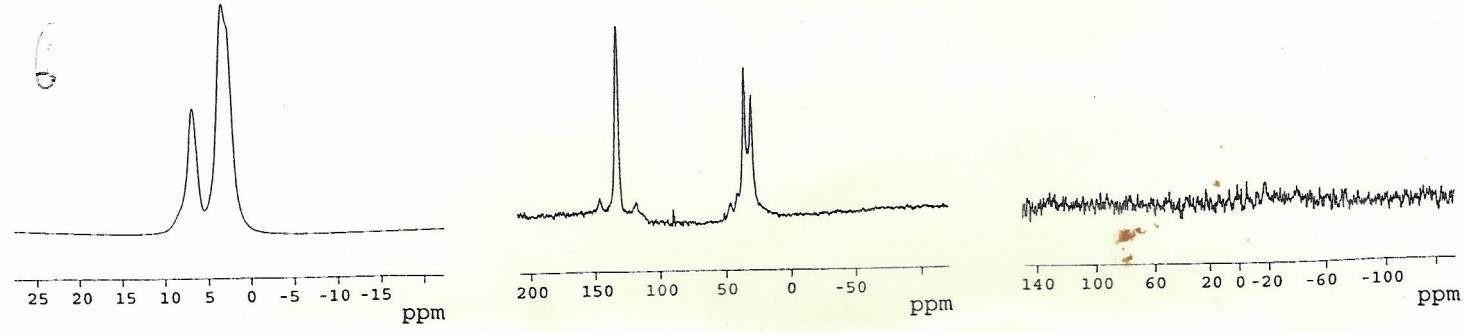
x16

Polyphenylene Sulfide (polyphenylene sulfide)

x16



HIPS (high-impact polystyrene)



PTFE (polytetrafluoroethylene, mica filled)

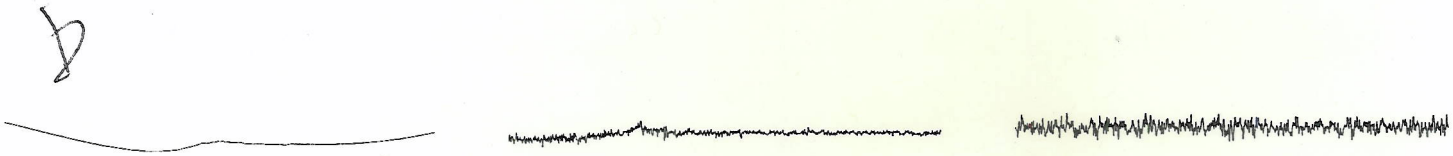
x16

7

Ertalyte (polyethylene terepthalate)

x16

9

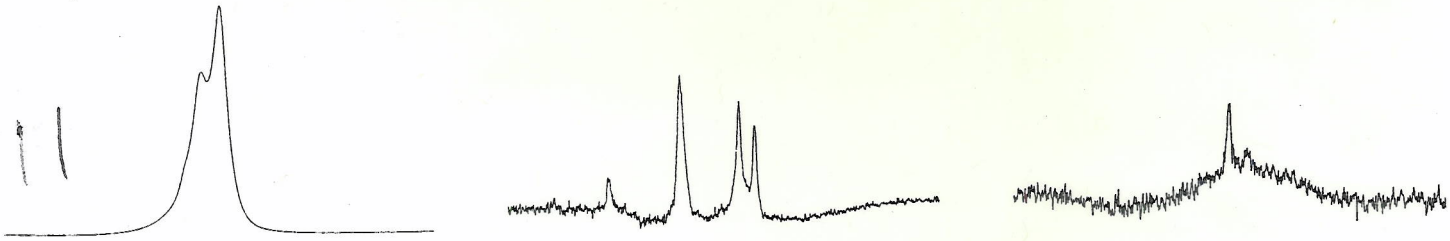


PVC/Acrylic (polyvinyl chloride/ polymethyl methacrylate)

10

Polyurethane (polyurethane, thermoset RIM)

11



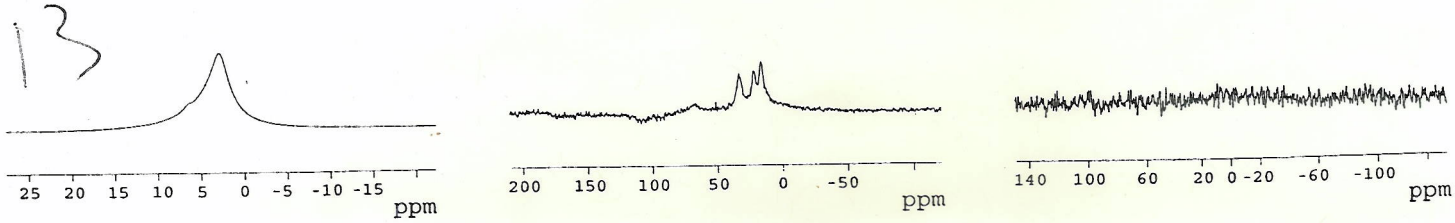
Polyurethane (polyurethane, thermoset Casting)

x16

12

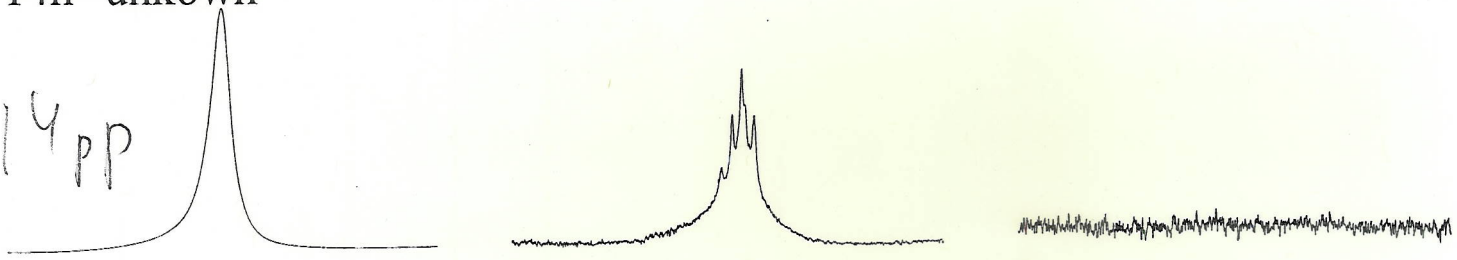
PVC/Acrylic (polyvinyl chloride/ polymethyl methacrylate)--white

13

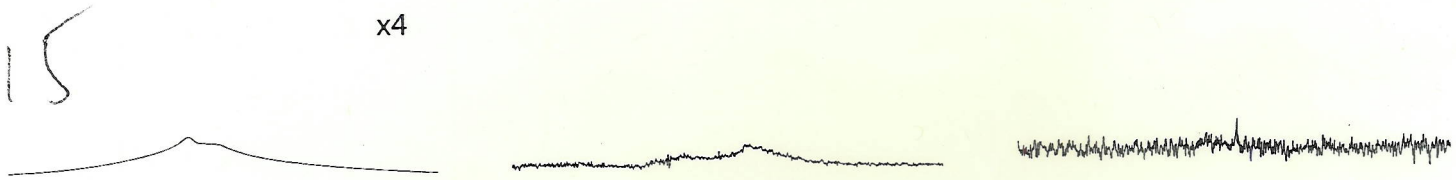


PVC/Acrylic (polyvinyl chloride/ polymethyl methacrylate)--blue

14n--unkown

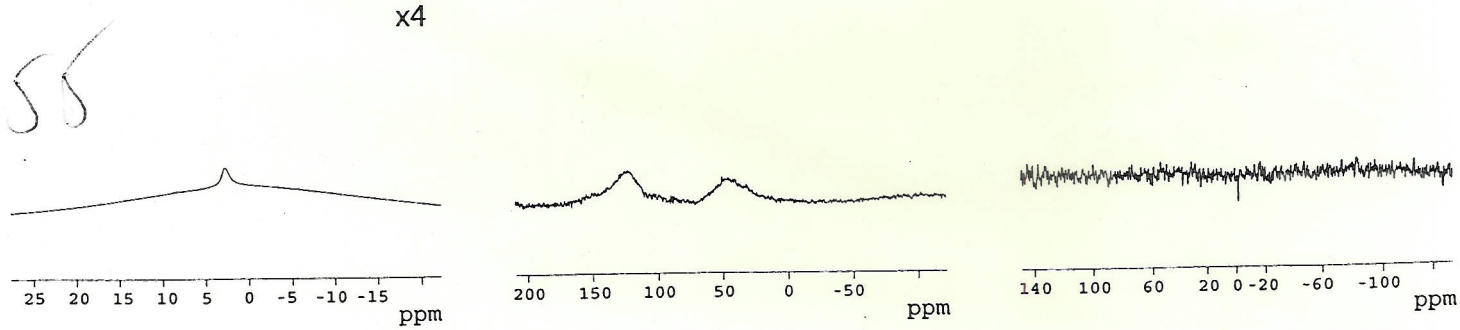


Polyurethane (RC-79D polyurethane)



Polyurethane (TD 277-02 polyurethane)

PVDF (Kunar)



1.0 BACKGROUND

High Field NMR requires that the background signal from the probe construction materials used in the device does not interfere with the signal from the sample. Subsequently it is necessary to perform an NMR analysis on all construction materials to be used within the probe.

2.0 PURPOSE AND SCOPE

In this experiment we will perform an NMR analysis on a variety of construction materials. We will also identify the materials suitable for High Field NMR and MRI applications. With these results we will produce a materials matrix that will contain information necessary for selecting the construction materials for NMR probes and RF coils for High Field MRI. The focus of the experiment is to verify which of the sample materials are suitable for the construction of a 3T ^{1}H TEM head coil for commercial application.

3.0 REFERENCES

- E.E. Babcock, J.T. Vaughan, B. Lesan, R.L. Nunnally. Multinuclear NMR Investigations of Probe Construction Materials at 4.7T. Magn Reson Med 1990; 13: 498-503.

4.0 TEST SETUP

We selected 14 sample materials to be considered for NMR probe construction; they were supplied by independent manufacturers and fabricated into 3-in. lengths of 1-in. diameter rod. The testing will take place on the 9.4T/31cm Varian System at the University of Minnesota's Center for Magnetic Resonance Research (CMRR). The samples will be analyzed using five 1-in. diameter solenoid coils each tuned and matched to a frequency of interest: ^{1}H (400.2 MHz), ^{13}C (100.6 MHz), ^{19}F (376.5 MHz), ^{23}Na (105.9 MHz), and ^{31}P (162.0 MHz).

5.0 TEST CASES

Each sample will be subjected to Free Induction Decay (FID) analysis covering the five established frequencies using the RF coils described above. The FID sequence and parameters will be determined by a qualified technician/scientist at the CMRR. Those results will be processed and recorded as NMR Spectra results for each sample material in the Test Results section (6.0).

After reviewing the data obtained from each sample we will determine which materials are suitable for probe construction, and the resulting definitions will be placed into the material matrix described above.

6.0 TEST RESULTS

6.1 Method / Test Parameters

The following sections to be completed during materials testing:

Sequence Description:

Sequence Parameters:

Signal Processing Description:

Misc. Description:

6.2 Sample Results

Table 1: Sum of FID

Materials	1H	13C	19F	23Na	31P
1: Acetal					
2: PEEK					
3: Nylon 6/6					
4: Ultem					
5: Polyphenylene Sulfide					
6: HIPS					
7: PTFE					
8: Ertalyte					
10 ~~9~~: PVC/Acrylic: Royalite					
11 ~~10~~: Polyurethane, RIM					
12 ~~11~~: Polyurethane, Casting					
13 ~~12~~: PVC/Acrylic, Kydex-100: White					
14 ~~13~~: PVC/Acrylic, Kydex-100: Blue					
15 ~~14~~:Polypropylene (white)					
Too Large ↓ 15 ~~15~~:RC 79D too large					
16 16:TD 277-02 too large					
17:					

Table 2: Presence (+) or Absence (-) of NMR Signal

Materials	1H	13C	19F	23Na	31P
1: Acetal					
2: PEEK					
3: Nylon 6/6					
4: Ultem					
5: Polyphenylene Sulfide					
6: HIPS					
7: PTFE					
8: Ertalyte					
10 ~~9~~: PVC/Acrylic: Royalite					
11 ~~10~~: Polyurethane, RIM					
12 ~~11~~: Polyurethane, Casting					
13 ~~12~~: PVC/Acrylic, Kydex-100: White					
14 ~~13~~: PVC/Acrylic, Kydex-100: Blue					
15 ~~14~~:Polypropylene					
Too Large ↓ 15 ~~15~~:RC 79D Too large					
16 16:TD 277-02 Too large					
17:					

Listed by id number, composition, and manufacturer are the NMR probe construction material candidates. Comment on the test results for each material's level of background signal found during the 9.4T experiment. Also recommend which sample materials could be used for the construction of a 3T ^{1}H single tuned TEM head coil for commercialization.

Table 1: NMR probe constructions material candidates

ID	Material	Composition	Manufacturer – Product Name
1	Acetal 1 sample	Polyoxymethylene Copolmer (POM)	Quadrant EPP – Acetron GP, unfilled extruded
2	PEEK 1 sample	Polyetheretherketone (PEEK)	Quadrant EPP – Ketron, PEEK 1000 unfilled extruded
3	Nylon 6/6 1 sample	Polyimide	Quadrant EPP – Nylon 101, type 66 nylon unfilled extruded
4	Ultem 1 sample	Polyetherimide (PEI)	Quadrant EPP – Ultem 1000, unfilled extruded
5	Polyphenylene Sulfide 1 sample	Polyphenylene Sulfide (PPS)	Quadrant EPP – Techron, unfilled extruded
6	HIPS 1 sample	High-Impact PolyStyrene (HIPS)	TMX Ain Plastics
7	PTFE 1 sample	Polytetrafluoroethylene (PTFE), Mica Filled	Quadrant EPP – Fluorosint 500, synthetic mica-filled, compression molded

8	Ertalyte 1 sample	Polyethylene Terepthalate (PET-P)	Quadrant EPP – Ertalyte, unreinforced, semi-crystalline thermoplastic polyester
No sample tag → 9 ~~10~~ 10 on Bag	PVC/Acrylic 2 samples	Polyvinyl Chloride/Polymethyl Methacrylate	Uniroyal Technology Corp – Royalite R52, color: Ultra White
~~10~~ 11 on Bag	Polyurethane 2 samples	Polyurethane, Thermoset RIM	Bayer AG Polyurethanes Div. - BAYDUR® 110 FR RIM Polyurethane, color: yellow
~~11~~ 12 on Bag	Polyurethane 2 samples	Polyurethane, Thermoset Casting	Innovative Polymer – TD 277-02, color: white
~~12~~ 13 on Bag	PVC/Acrylic 2 samples	Polyvinyl Chloride/Polymethyl Methacrylate	Kleerdex – KYDEX 100, color: White
~~13~~ 14 on Bag	PVC/Acrylic 2 samples	Polyvinyl Chloride/Polymethyl Methacrylate	Kleerdex – KYDEX 100, color: Blue
Too thick ~~14~~ ~~15~~ 14 No Bag pp	Polypropylene (white) 1 sample		Seelye – Eiler Plastics opaque white
	labeled w/ Red Pen		
Too large ~~15~~ 15	RC 79D (yellow) 2 (too large) samples		PDS Plastics

16 16	TD 277-02 (white) 2 samples ~~3~~ Too large		PDS Plastics
~~12~~ #55	PVDF 1 sample	Kynar	white

TOO large

Experimenters: Test Date: